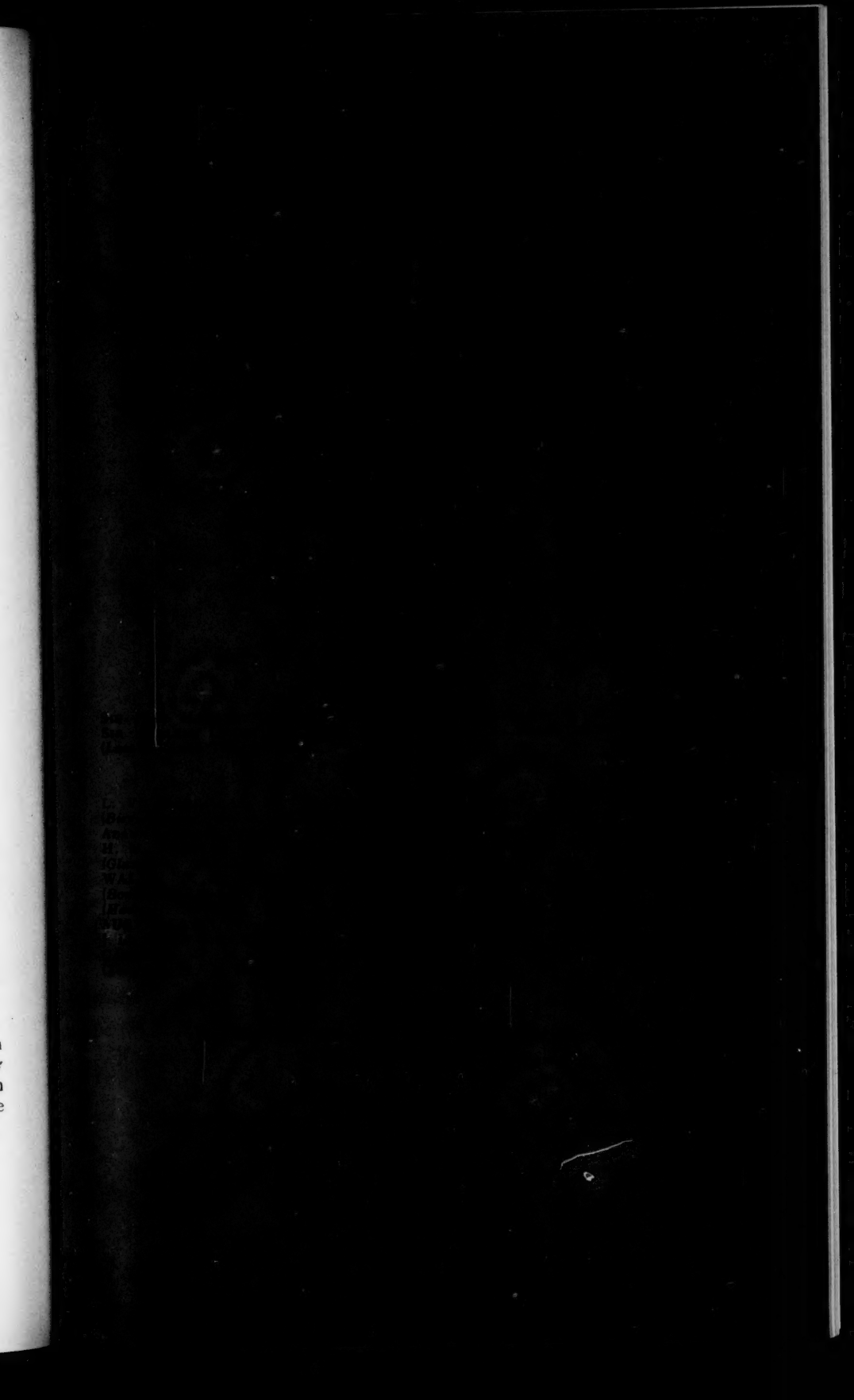


THE BRITISH JOURNAL

OF

OPHTHALMOLOGY

MARCH, 1942

COMMUNICATIONS

OPERATION FOR CATARACT

Closure of the Wound. Frequency of Complications with Different Methods of Extraction

BY

M. KLEIN

LONDON

OPERATION for cataract—which has already reached a high standard—is still not entirely free from danger, the elimination of which would be an important achievement. Only clinical experience can furnish us with the knowledge necessary for further improvement.

A statistical survey of a large number of cases should provide us with a sound critical basis, and may indicate the direction for further improvement in technique. Furthermore, observation of patients over a long period may shed light on the circumstances in which complications occur, and may indicate the measures requisite for their prevention. Complications and their treatment are of the utmost importance, not only because they increase the difficulties and anxieties of the surgeon, but chiefly because the outcome of the complications plays a part in the final result of the operation.

This review is based upon 650 cataract operations which were performed in the Ophthalmic Department of the Jewish Hospital in Budapest, between 1933-1938. Of these 650 operations 265 were upon men and 385 upon women. The age of the patients varied from 25 to 91 years. Details are given in Table I.

With regard to the physical condition of the patients 12·5 per cent. were diabetic and in 6 per cent. there was pre-existent glaucoma. The incidence of hyperpiesia and other diseases was in accordance with the general distribution.

The pre-operative treatment consisted of a general examination of the patient and the bacteriological examination of the conjunctiva. In the general overhaul constitutional factors as well as diseases must be considered. As a routine, consideration should

TABLE I

Age	Male	Female	Total
21-25	4	—	4
26-30	—	—	—
31-35	1	6	7
36-40	2	6	8
41-45	5	7	12
46-50	13	19	32
51-55	15	16	31
56-60	30	41	71
61-65	49	56	105
66-70	44	82	126
71-75	52	82	134
76 80	35	51	86
81-85	14	11	25
86-	1	8	9
Total ...	265	385	650

Mean : $66 \pm 0{\cdot}35$ $\sigma = 13{\cdot}25$

be given to urine, blood pressure, coughing, bowels, blood-sugar in case of diabetes, and other tests if necessary. The patient was admitted a few days before operation and made as fit as possible. If the conjunctiva was not clean ung. hydr. flav. dil. with bandage was used. In patients sensitive to mercury, noviform ointment was used as a conjunctival antiseptic with satisfactory results. The patient's co-operation should be secured by exercises such as gentle closing of the lids, making the patient look down, and practice with eye drops. Twenty centigrams of luminal was given the night before, and the same dose an hour before operation.

Anaesthesia.—Half an hour before operation a retrobulbar injection of ½-1 c.cm. of 4 per cent. novocain was given. The novocain solution contained pituitary extract (1-1½ per cent., pars post.) instead of adrenalin as this is free from the undesirable effects of adrenalin. The novocain solution, as well as the eyedrops, was made up with 1 :80,000 vuzintoxin (nuvotox) as antiseptic. A drop or two of novocain was injected into the lids at the place where

the lidholding sutures were to be inserted. In practically all cases akinesia was obtained by injecting 1 per cent. novocain into the orbicularis muscle. This prevented the patient from screwing up the eyes. For conjunctival anaesthesia 0·5 per cent. pantocain solution was used. This and 1 : 1000 adrenalin were dropped into the eye alternately every two minutes, giving 4-5 drops of each. Anaesthesia was excellent, and complete dilatation of the pupil was achieved, and persisted even after the opening of the anterior chamber. In only a few cases was it necessary to instill one or two drops of homatropine to dilate the pupil.

Technique of operation.—The lids were held apart by stitches inserted into them. I preferred stitches to the speculum, as the latter may exert pressure on the eyeball. A stitch was also put into the superior rectus muscle (retraction suture) as this is a very effective means of keeping the eyeball in the desired position. To ensure a good closure of the wound a corneo-scleral stitch was then inserted, as a rule Liégard's stitch was used. The insertion of this stitch is simplified if a small two-pronged fork is used for fixing the cornea. As will be seen later, closure of the wound by means of a corneo-scleral stitch shortens the time of healing after a cataract operation and reduces the probability of some of the complications. The corneo-scleral stitch is very important as a provision for security of wound closure after cataract operations and it deserves more general recognition.

After the corneo-scleral stitch had been inserted, a corneo-scleral incision with conjunctival flap was made with a Graefe knife. As a rule a peripheral iridectomy was made. Complete iridectomy was performed only in selected cases, *e.g.*, in case of rigid iris with insufficiently dilated pupil, posterior synechiae, pre-existent glaucoma etc. The extraction was then made with forceps by the tumbling method. In most cases Arruga's capsule forceps were used, but if it was impossible to get a grip of the capsule with these forceps, Blaskovics's or Imre's forceps were employed. The lens was loosened by gentle pulling with the forceps and gentle pushing with the squint hook, then dislocated and carefully removed. When the lower edge of the lens was lifted to the lower third of the cornea the forceps were removed and the cataract expressed by a gentle push with a squint hook.

Replacement of the iris followed, but if any complication had arisen during operation the corneo-scleral stitch was first knotted and the iris then replaced. At the end of the operation a drop of 1 per cent. oily eserine and a drop of 25 per cent. argyrol was instilled.

As a result of the novocain injection into the orbicularis muscle the patient was unable to close the eye, so that the upper lid had to be pulled down by the threads of the lid stitch, and these were

fixed to the face of the patient by a strip of adhesive. No dressing with gauze or cotton wool was used. Only a metal shell was fixed over the operated eye by means of adhesive straps. In this way good protection was achieved without any pressure, and the eye was kept shut under the metal shell. The other eye was covered with a pad, fixed by adhesive.

The dressing was changed next day. The lid stitches were removed and a drop of atropine given, and from this day onward the second eye was not dressed.

The operations were performed by the medical staff of the department, some of whom were new to this branch of work.

Generally intracapsular extraction was intended but was not always carried out. In cases where the forceps slipped off, or where the capsule was so tensely stretched as to be incapable of being gripped, capsulotomy was performed with the forceps. Few cases were regarded beforehand as unsuitable for intracapsular operation. For the first few operations beginners performed the extracapsular operation.

Table II gives details of the operated cases.

TABLE II

Method of wound closure	No. of operations	Intra-capsular Cases			Extra-Capsular Cases		
		No.	Iridectomy Periph.	Complete	No.	Iridectomy Periph.	Complete
A. Conjunctival flap ...	84	49	28	21	35	12	23
B. Kuhnt's apron ...	109	74	58	16	35	19	16
C. Corneo-scleral stitch...	457	326	256	70	131	81	50

As seen above, in the majority of cases wound closure was secured by means of a corneo-scleral stitch. But the number of cases with the other two methods of wound closure is large enough to enable us to assess their comparative value.

In group A (Table II) the wound and conjunctival flap were made with the Graefe knife and no suture was used (A in Fig. 1). In group B (Table II) a conjunctival apron was first separated after Kuhnt, followed by a corneo-scleral incision with Graefe's knife. After extraction of the cataract the conjunctival apron was pulled down so as to cover the wound. The apron was kept in position by a suture on each side of the limbus (B in Fig. 1). In group C (Table II) a corneo-scleral stitch was used for wound

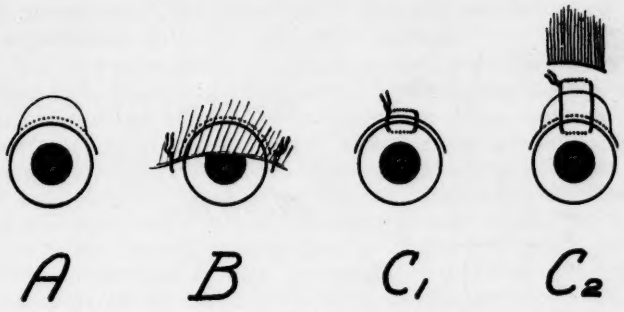


FIG. 1.

A, flap section; B, Kuhnt's apron; C_1 Liégard's short stitch; C_2 Liégard's long stitch, there is space enough for the conjunctival flap.

closure. In the earlier cases use was made of the shorter corneo-scleral stitch in which the distance between the corneal and scleral points was only two millimetres (C_1 in Fig. 1). Later, however, we adopted the longer corneo-scleral stitch, *i.e.*, with the corneal point located as before but the scleral point rather higher, some five millimetres above the top of the limbus and a little below the superior rectus muscle, since in this way it was possible to leave room for a reasonable conjunctival flap, cut with Graefe's knife (C_2 in Fig. 1).

The corneo-scleral stitch was removed on the 5-7th day, but Stallard's suggestion not to remove it before the 12-14th day is probably better, as by this time wound closure is firmer.

The effect of wound closure on healing after cataract operation may be assessed by the number of days from operation to discharge of the patient from hospital.

Details are given in Fig. 2.

The average number of days the patient was kept in hospital after operation in conjunctival flap cases was 13·36 days, in Kuhnt's apron method 12·32 days, while in cases where corneo-scleral stitch was used it was 11·18.

From this it is clear that the conjunctival flap method demands the longest period of postoperative hospital treatment and the corneo-scleral stitch method the shortest.

Statistical analysis may here be usefully employed to determine whether this observed difference is conditioned by the method of operation, and therefore significant, or whether it is merely fortuitous. In the comparison of Kuhnt's apron group with the conjunctival flap group the probability that the difference of one day is of chance origin, is 0·009, *i.e.*, it would occur in this way nine times in a thousand, while in the comparison of corneo-scleral stitch group with Kuhnt's apron group the probability is 0·000004, *i.e.*, the difference would be of chance origin four times in a million. It may, therefore, be concluded that of these types of wound closure examined, the method employing the corneo-scleral stitch requires the shortest time for healing.

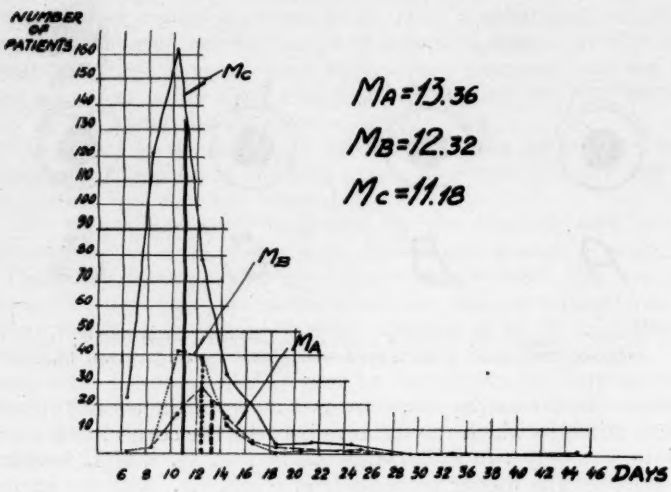


FIG. 2.

Curve showing the duration of hospital treatment with different methods of wound closure. . . . . flap; . . . . Kuhnt's apron; — corneo-scleral stitch.

The effect of wound closure on the postoperative visual acuity is not so apparent as in all three methods of wound closure the visual acuity was near to 5/10. The exact figures of visual acuity were: conjunctival flap, Mean Vision 0·555; Kuhnt's apron, Mean V. 0·514, and corneo-scleral stitch, Mean V. 0·56. It will be observed that the degree of visual acuity is equally good following conjunctival flap and corneo-scleral stitch wound closure but not quite so good following Kuhnt's apron method. A statistical analysis (*vide* Klein, 1939) has shown that this difference is significant and we may therefore assume that visual acuity tends to be better after conjunctival flap and corneo-scleral stitch operations than after those in which Kuhnt's apron is employed.

Comment.—Conjunctival flap wound closures are followed by very good visual acuity, practically the same as after the employment of a corneo-scleral stitch, but in respect of the duration of hospital treatment they are the least satisfactory. The operation itself is perhaps simpler to perform than the other two, but has the defect that the closure of the wound is entirely dependent on the adhesion of the wound lips to one another and of the conjunctival flap to its basis.

Kuhnt's apron method stands, so far as concerns the requisite hospital treatment, between the conjunctival flap and corneo-scleral

stitch operations. The mean visual acuity is somewhat less than that experienced with the other two methods.

In this operation the conjunctival apron covers the wound and is drawn tightly over it. A bad feature is that during the separation of the conjunctival apron, haemorrhage may occur, which hinders the performance of the operation. Moreover the apron covers the upper part of the cornea, with the result that iris prolapse may occur unobserved. Again when the conjunctiva has retracted to its normal position, it sometimes happens that a small part of it adheres to the cornea, causing pain or discomfort to the patient. A further operation is then necessary in order to remove the attached part of the conjunctiva from the cornea.

It is well known that for rapid and undisturbed healing of the wound the incision should be smooth, and the lips of the wound should be as close together as possible. The latter condition can best be secured by the use of a corneo-scleral stitch, since a stitch that penetrates the cornea and scleral tissues is more effective and resistant than one which binds the loose conjunctiva only. This was confirmed in Hilding's experiments in which he examined the resistance of the wound after different wound-closure methods. The experiments also confirm our clinical experience that the most efficient wound closure is achieved when the corneo-scleral stitch is reinforced by a conjunctival flap, which gives an additional protection.

Complications arising out of cataract operations. Vitreous complication

The term generally used is " prolapse of the vitreous," implying that during or after the cataract extraction vitreous appears in the wound, and some vitreous loss may occur. In this paper, however, not only actual vitreous prolapse and loss, but also all cases where the anterior chamber was reformed during the operation, have been classified as " vitreous complication."

The most common cause of vitreous complication is pressure on the eyeball during operation; this may be exerted by the surgeon or his assistant, or as sometimes happens, by the patient screwing up the eye. On the other hand the trouble may originate within the eyeball itself, for instance when the vitreous has become liquefied and assumed a watery consistency. In such a case it may enter the wound as soon as the incision has been made with Graefe's knife. More often the liquefied vitreous is held back in the vitreous chamber by the zonula lens diaphragm only, and after a typical intracapsular extraction—when this wall has been removed—the anterior chamber suddenly reforms or becomes even deeper than normal and vitreous may enter the wound. This is

common in cases of malignant myopia or longstanding unilateral cataract. Another—though very rare—cause may be that the posterior lens capsule has become attached to the vitreous membrane and some vitreous may be drawn out together with the cataract.

It is probable that there is some connection between the type of cataract and the occurrence of vitreous complication. Greenwood and Grosman have found, in a series of intracapsular operations, that the frequency of vitreous loss was least with immature cataracts (2·8 per cent.), with mature cataracts the frequency increased (8·4 per cent.), a further increase was noticed with hypermature and non-complicated posterior cortical cataracts (about 11 per cent.), and the maximum frequency of vitreous complications was with complicated posterior cortical, traumatic and other types of complicated cataracts (22-25 per cent.).

The question whether vitreous complication is more frequent with intra- or extra-capsular extraction is still open. It appears that the majority of authorities hold the view that it is more frequent wth the intra-capsular method. On the other hand reliable operators (Knapp, Fleischer, Passow, Sourdille) have found no difference in the frequency of vitreous complication in the two methods of extraction, while according to others (Gradle, Meesmann) vitreous complication is more frequent with extra-capsular extraction. In my material vitreous complication was slightly more frequent with intra-capsular extraction.

Interesting and instructive are the records of Knapp which give details of the stage of the operation when vitreous loss occurred. Out of 42 cases five occurred after making the incision, twelve during the loosening of the lens, twelve after the delivery of the lens and thirteen towards the end of the operation (return of the pillars of iris coloboma, etc.).

Danger to the eye due to vitreous complication may be attributed to the following factors: damage to the vitreous, infection, and secondary damage caused by adhesions of the iris to the wound.

Minor damage to, or small loss of vitreous has no ill effect on the eye. This is a well known fact in cataract operations, and also in several other operations in which the vitreous may be involved. For instance in posterior sclerotomy a small amount of vitreous is let out. In his anti-glaucoma operation Lindner burns a small hole into the sclera through which he introduces an iris repositor to disintegrate the neighbouring parts of the vitreous. In this case the *vitreous loss* is caused purposely. In case of vitreous floaters zur Nedden has found that after sucking off a little vitreous the floaters absorbed. In the heroic age of the detachment operation the amount of vitreous loss during operation —in consequence of the multiple perforations of the sclera—was

sometimes so large that at the end of the operation the globe was almost collapsed, and yet it was found that the operated eyes recovered.

These examples show that the eye can overcome a certain loss of vitreous, but it would be very difficult to assess the amount of vitreous the loss of which is irreparable.

The second factor is infection, which represents the greatest danger to the eye. In my cases of post-operative infections, however, vitreous complication was not unduly frequent. The chance of infection following extractions with vitreous complication during operation is not greater than that of uncomplicated cases. It seems that if vitreous is incarcerated in the wound, infection may spread into the eye along the vitreous track. With the new methods the wound closure is more perfect, and if the incarcerated vitreous-thread has been cut off and the wound covered with conjunctiva (to keep away the conjunctival bacteria from the wound), infection of the eye is in most cases avoidable.

Damage to the eye caused by adhesion of the iris to the wound: see section Elevation of the Pupil, etc.

In this paper an account is given of 48 cases of vitreous complication (7·4 per cent.). Their frequency among male patients was about three times that of females. It is noteworthy that in about 25 per cent. of the vitreous complications the eyes were myopic. The vitreous complication had no influence on the healing time of the cataract operation; the number of hospital days was about the same as the general average. Vision of the vitreous complicated cases: 5/5-5/15, 33; 5/25-5/50, 10; less than 5/50, 5 cases. In all five cases with less than 5/50, the bad vision was caused by some pre-existing pathological change in the eye (corneal scars, fundus and optic nerve changes). Observation over a long period has shown that vitreous complication during extraction has practically no late effect upon the eye.

Perfect anaesthesia is most important if the vitreous complication is to be avoided—the patient must not feel pain even during the iris excision—as are orbicularis akinesia which prevents the patient from screwing up the lids and the retrobulbar novocain injection which, besides contributing to the completeness of the anaesthesia, lowers the intra-ocular pressure. Other factors are: co-operation of the patient, the administration of sedatives before the operation, avoiding all unnecessary pressure on the globe, and finally, the corneo-scleral suture which enables us to close the wound immediately in case of vitreous complication, thus preventing loss of vitreous if possible. Elschnig suggests filling up the A.C. with air by means of a syringe.

Analysis of these records has shown that vitreous complication has no ill effect on healing after cataract operation and that the

eye suffers practically no damage from it. This view holds true —I think—for most of the cases of vitreous complication except excessive loss of vitreous, a condition which is very rare but presents great danger to the eye.

Contrary to this opinion, many authorities regard vitreous loss as a most serious complication. Let us therefore examine the problem. Normally the vitreous occupies the space behind the zonula-lens wall and we must regard as pathological all cases in which there is a dislocation of the vitreous. During a cataract operation the mildest degree of vitreous dislocation occurs when it enters the A.C. and fills it, partly or completely. The clinical sign of this condition is that the A.C. is suddenly restored during the operation, or becomes even deeper than normal. If the volume of the dislocated vitreous is greater than that of the A.C. it bulges through the incision and part of it may flow out of the eye, resulting in vitreous loss. Sometimes the vitreous gets straight into the wound. The restoration of the A.C. is caused by vitreous flowing into it. If only one additional drop, more than sufficient to fill it, is dislocated, the result is bound to be " loss." But this so-called loss is in fact, as has been shown, precisely the same in nature as the restoration of the A.C.—dislocation of vitreous.

Vitreous disorders may occur not only during or after cataract extraction but also during the needling of juvenile cataracts when the knife penetrates into the vitreous either accidentally or intentionally, and consequently vitreous enters the A.C. The needling of pupillary membrane after cataract operation causes a small hole through which, in the majority of cases, vitreous gets into the A.C. It is interesting to note that authorities who take the most serious view of the vitreous complication during cataract extraction are usually in favour of extra-capsular extraction because vitreous loss with this is supposed to be less probable. But as after this operation needling is frequently necessary, the operator is eventually in a position when some kind of vitreous disturbance cannot be avoided.

It seems that opinions as to the dangers of vitreous complication have passed from book to book for many years unchallenged, whereas the cataract operation as a whole has undergone a thorough revision. The time has certainly come to review the matter in the light of experience with modern methods of operation. Any injury of the vitreous is certainly a complication, and the surgeon should exercise the greatest care to avoid it, but I am firmly of the opinion that the consequences and importance of vitreous complication—except excessive loss—have been exaggerrated hitherto.

Prolapse of the iris

Prolapse of the iris occurs when the following conditions are present: (1) re-opening of the wound with sudden overflow of aqueous; (2) the absence of an aperture in the iris (permitting the escape of aqueous from the posterior chamber); (3) increased intra-ocular pressure (Hilding). The increased intra-ocular pressure is the force which re-opens the wound, and the overflowing aqueous pushes the iris into the wound. In the absence of any of these conditions prolapse of the iris should not occur. The probability of re-opening of the wound can thus be diminished if the wound closure is reinforced by corneo-scleral suture; and by iridectomy which provides an outlet for the overflowing aqueous, without pushing forward the iris.

TABLE III

No.	Age	Sex	No. of hospital days	Mode of operation	Mode of iridectomy	Eye and general condition	Vis.	Vitr.	Elev. pupil	Prol. iris	Post-op. inflam.	+ I.O.P.	Hyph.
1	76	M	11	E.C.	Periph.	—	5/35	—	+	+	—	+	+
2	70	F	14	I.C.	P.	—	5/7	—	+	+	—	+	+
3	68	M	15	E.C.	P.	Post cort. cataract	5/5	+	+	—	—	—	—
4	63	M	16	E.C.	P.	Diabetic	5/15	—	+	+	—	+	—
5	68	F	16	I.C.	P.	Myopic eye	5/5	—	+	+	—	—	—
6	60	M	24	E.C.	P.	Old lues	5/10	—	+	+	—	—	+
7	75	F	20	E.C.	Complete	Complete Old glauc. cupped disc	C.F.	—	—	+	—	+	—
8	73	F	20	I.C.	C.	Old glauc.	5/7	—		+	—	+	—
9	61	F	15	I.C.	P.	Asthma. Graves' disease	5/7	—	—	+	—	—	—
10	63	F	28	I.C.	P.	Diabetic	5/5	—	—	+	—	+	—

M Male. F Female. I.C.=intra; E.C.=extracapsular.

1. Late iris prolapse. Cicatrisectomy. I.O.P. normal, a year later cupped, pale discs, V: C.F.

2. Late subconjunctival iris prolapse. After cicatrisectomy I.O.P. normal

6. Rupture of the wound, followed by iris prolapse accompanied by hyphaema and haemorrhage into the vitreous. Resorption after diathermy heatings and iodine

8. Transitory rise of I.O.P.

10. Transitory rise of I.O.P. Observed for 3 years.

As regards the frequency of iris prolapse after intra- or extra-capsular operation opinions are divided.

In this series 18 cases of prolapse of the iris have been recorded (2·8 per cent.). In 14 cases the prolapse occurred within eight days after the extraction, and in four cases a subconjunctival prolapse of the iris appeared later, after weeks or months.

The frequency among male patients was about half of that in females. The relative frequency of the complication after extra-capsular operation was more than twice that of the intra-capsular operations, while the type of iridectomy (peripheral or complete) had no effect on it. The healing period after cataract operation was considerably prolonged by prolapse of the iris, the average number of hospital days was 17·2 (min. 9, max. 28), a prolongation of about 25 per cent. over the general average. Vision : 5/5-5/15, 13; 5/25-5/50, 2; less than 5/50, 3 cases. Iris prolapse was associated with other complications in ten cases (Table III).

In one case (No. 3) in which vitreous complication arose during operation, the wound burst on the second day after operation, and iris prolapsed into the wound. Reparative iridectomy was performed immediately: healing time 15 days: vision 5/5. In three cases (Nos. 4, 5, 6), after resection of the incarcerated iris, the pupil became slightly drawn up, and in one of these an increase of the intra-ocular pressure developed. In two cases the iris prolapse was a late complication. In both cases there was a slight haemorrhage into the A.C. during the healing period, and some weeks later a slight elevation of the pupil was observed. Increased intra-ocular pressure, together with subconjunctival prolapse of the iris, developed weeks or months after the operation (Cases 1, 2). The treatment in these cases was resection of the prolapsed iris and excision of the bordering scar (cicatrisectomy). In two further cases (7, 8), the raised intra-ocular pressure cannot be attributed to the iris prolapse, as the patients had been under treatment for glaucoma before the operation. In both these cases the use of pilocarpine drops was sufficient to keep down the intra-ocular pressure. No. 9 was an asthmatic patient and prolapse occurred during an asthmatic attack. No. 10 diabetic, intra-ocular pressure normal: observed three years.

In prevention of iris prolapse the following points are important. Co-operation of the patient; he must, for instance, observe all instructions, he must be quiet, avoid squeezing the eye during the change of dressing or when eyedrops are put in, and avoid external pressure upon the eye. An iridectomy should be performed so that the aqueous may escape without causing iris prolapse. Perhaps the most important of the preventive measures is the use of the corneo-scleral suture for wound closure. The suture must be symmetrically inserted on the corresponding points of the sclera and cornea, otherwise the adaptation of the wound lips is not satisfactory.

The treatment of iris prolapse belongs to the domain of reparative surgery. In recent cases eserine drops and hot bathing may be tried, but they are usually without effect. In cases where the iris prolapse is covered with conjunctiva some authorities advise postponement of operation for some time, but in this series operation was undertaken without delay in all but the late cases, and the results were good. In this operation perfect anaesthesia is

essential, and for this purpose retrobulbar novocain injection is advisable. In cases where corneo-scleral suture had been employed the operation for prolapse is much simpler and less dangerous, as in most cases the operation can be done without cutting the stitch. First the conjunctiva covering the iris prolapse is freed by means of a blunt instrument, *e.g.*, a canaliculus probe, then the iris is separated from the wound edges and resection of the prolapsed iris performed. The pillars of the iris coloboma are then returned into the A.C. with an iris repositor. The conjunctival flap is then replaced to cover the wound. If there is a gap between the corneo-scleral wound lips, a deep suture may be necessary to secure wound closure. If, together with the iris prolapse, vitreous prolapse occurs, resection of the vitreous prolapse with subsequent diathermy coagulation is recommended (Albrich).

Late subconjunctival iris prolapses are usually preceded by elevation of the pupil, and they develop gradually. The prognosis in these cases is serious.

The importance of iris prolapse is well brought out in the following quotation from Blaskovics (Blaskovics and Kreiker: Eingriffe am Auge): " In case of prolapse of the iris and vitreous, immediate operation is necessary only in cases where the corneal flap has been bent over, either outward or inward. Otherwise it is better to wait a few days and to keep the eye bandaged . . . Under complete akinesia the wound is reopened, the prolapsed vitreous resected and the iris returned into the A.C.—or we endeavour to return it. If this is unsuccessful the prolapsed iris has to be resected. The operation is rather difficult, there is constant danger of new vitreous prolapse and collapse of the globe. In most cases there is a haemorrhage into the anterior part of the vitreous; good vision is hardly to be expected. Infection, chronic irido-cyclitis, and detachment of the retina may follow."

In my material the outcome of the iris prolapse cases was not so grave—it may be said it was relatively good—and I feel certain that this may be attributed to the use of the corneo-scleral suture. The value of this suture can easily be appreciated if we consider that the incision of a cataract operation has a length of about 13-15 millimetres. When we use a corneo-scleral stitch, the central part of the wound is firmly held together for a length of 1·5-2 millimetres so that on each side there remains a wound only about six millimetres long. Such a reduction in the length of the wound makes the probability of a complication (reopening or bursting of the wound) much less than the simple arithmetical ratio between the two lengths. The area of an incision 13-15 millimetres long is about six times as large as that of one 5-6 millimetres long, and the danger attendant upon the re-opening of such a large wound is obvious.

Elevation of the pupil and pillars of iris colobomata, and irregular shape of the pupil after cataract extraction

The cause of elevation of the pupil may be incarceration (adhesion) of the zonular fibres in the wound (Kubik), inflammatory changes around the wound (Treberova), or incomplete rupture of the wound, when only the intra-ocular edges of the wound are separated. Elevation of the pupil is relatively frequent after vitreous complicated cataract operations.

This series contains 19 cases of elevation of the pupil or pillars of colobomata (2·9 per cent.), and 17 cases where the shape of the pupil became irregular after cataract extraction. These two groups will be discussed together. The occurrence of this complication was slightly higher with male patients than with females. With extra-capsular extraction the frequency was a little more than with intra-capsular (6 per cent. and 5·35 per cent. respectively). The type of iridectomy was practically without any influence. Visual acuity : 5/5-5/15, 33; 5/25-5/50, 2; less than 5/50, 1 case. In some of these cases, however, increased intra-ocular pressure gradually developed, leading to deterioration or loss of vision (a description appears below).

Study of the cases has shown that we have to distinguish two separate groups. In the first are the cases in which there was vitreous complication during the extraction. This group is marked by the absence of any serious consequences to the eye. Altogether eleven such cases were recorded (eight intra-, three extra-capsular extractions) and in ten cases the eyes remained perfectly quiet, in only one case a " late " complication arose which probably had no connection with the cataract extraction.

CASE 11. Woman, aged 69 years, diabetic. Extra-capsular extraction with peripheral iridectomy. Vision 5/25, remnants of lens matter. A year after the extraction acute irido-cyclitis occurred with raised intra-ocular pressure, and, after settling down, vision was reduced to C.F. 1 metre.

In the second group are those cases in which the cataract extraction was perfectly normal, without any complication, and weeks or months later some disorder developed. Twenty-five cases belong to this group, and in thirteen of them the intra-ocular pressure became raised, this led to a substantial reduction of vision in three cases.

CASE 12. (*a*) Man, aged 50 years, extra-capsular extraction with peripheral iridectomy. Vision 5/10. Six weeks later acute glaucoma developed, which was preceded by progressive elevation of the pupil. Neither miotics nor repeated operations had any effect. The eye was lost.

CASE 13. (*b*) Man, aged 64 years, intra-capsular extraction with peripheral iridectomy. Vision 5/10. Two months later attack of glaucoma, cyclodialysis brought the intra-ocular presure back to normal. The patient did not attend for a year, cupping and paleness of the disc were found and the vision was C.F. 1 metre.

(*c*) In one case the elevation of the pupil and the raised intra-ocular pressure were associated with late subconjunctival iris prolapse (case No. 1, Table 3).

Among the 13 cases with raised intra-ocular pressure, six were

intra-capsular (1·3 per cent. of all intra-capsular operations), and seven extra-capsular (3·5 per cent. of the extra-capsular operations).

In the remaining twelve patients of this second group the pupil distortion had no ill effect on the eye. Vision and intra-ocular pressure remained unchanged and it was not possible to give any certain explanation for the development of the abnormal pupil. In three cases there was a small haemorrhage in the A.C. during the healing period, which may have been the cause. In the other nine cases the operation, as well as the healing period, was entirely free of complication. I observed one case in which the pupil was perfectly central for twelve months after the extraction and it was not until later that the elevation of the pupil began. This was progressive and eventually the pupil became drawn up completely and looked like a " complete " iridectomy.

If distortion of the pupil is to be avoided it is important that every phase of the operation should be performed with the correct technique. Lens matter, zonular fibres, capsule or vitreous must not get into the wound. If there is vitreous prolapse during the extraction it has to be cut off by means of de Wecker's scissors. The suggestion of Elschnig to fill the A.C. with air as a prophylaxis against elevation of the pupil, is certainly worth trying. In early cases Arndt recommends a simple operation. He introduces a Lang knife into the A.C. near the site of the pupil elevation and as the iris in this stage is only loosely fixed it is possible to separate and return it to its normal position. To assure the central position of the pupil he gives eserine drops for a few days. In some cases it is possible to separate the adhesions between iris and wound by means of cyclodialysis, but we have to employ a somewhat longer spatula than is usually employed. If the pupil disorder is associated with other complications, *e.g.*, raised intra-ocular pressure, the treatment has to be adapted accordingly.

The follow-up study of cases with pupil disorders after cataract operation has shown that they form two well differentiated separate groups. To the first belong cases in which there has been vitreous complication during the extraction. In these cases the pupil disorder has very little significance and causes no harm to the eye. In the second group are the cases of cataract extraction without any disturbing event. This group has a serious prognosis, as in thirteen out of twenty-five cases the post-operative pupil disorder was associated with raised intra-ocular pressure, and in three of them the vision, which was good after operation, became reduced or was entirely lost.

Increase of intra-ocular pressure

The most frequent causes of this complication are: post-operative irido-cyclitis, enclosure of iris tissue or lens capsule in

the wound, and intra-ocular haemorrhage during or after the extraction. Many authorities attach some significance to the vitreous hernia which may bulge into the A.C. through the pupil in case of intra-capsular extraction, or through a hiatus in the posterior capsule in case of extra-capsular extraction. But according to De Saint Martin in a series of 36 cases he found no rise of intra-ocular pressure. The adhesions between vitreous and pupillary margin of the iris are a potential source of post-operative secondary glaucoma (Sinclair).

The method of extraction plays an important rôle, and the opinion is unanimously accepted that the rise of the intra-ocular pressure is far more frequent with extra-capsular extractions than with intra-capsular ones. Gifford describes eleven cases, and all developed after extra-capsular extraction. Fox has found secondary glaucoma in 1·2 per cent. in a series of 1,182 cataract operations, and all occurred after extra-capsular extractions (quoted from Gifford). De Saint Martin had only four cases of secondary glaucoma among 654 intra-capsular extractions.

In the present series of operations, I found twenty cases in which there was a rise of intra-ocular pressure or secondary glaucoma. The average number of hospital days were 13·6 days, which shows that there was little disturbance during the immediate post-operative period, and that raised intra-ocular pressure is a late complication. The frequency among men was about double that of women. Vision at discharge: 5/5-5/15, 14; 5/25-5/50, 4; less than 5/50, 2 cases. In four cases there was a deterioration of vision later.

This series contains five cases in which there was a long standing glaucoma previous to the cataract operation. In eight cases the rise of intra-ocular pressure was transitory, and it was possible to keep it within normal limits by the use of miotics. The intra-ocular pressure became normal after a while and the eyes suffered no damage. In seven cases, however, the raised intra-ocular pressure persisted, and they had to use miotics permanently or, if this was insufficient, it was necessary to perform one or more operations.

Pre-existent glaucoma: five cases. In four of them the intra-ocular pressure was kept normal with miotics; in the fifth acute glaucoma developed and progressed unfavourably.

CASE 14. Man, aged 75 years, had treatment for glaucoma for many years. Extra-capsular extraction with complete iridectomy. Operation and healing without complication, discharged eleven days after operation. The intra-ocular pressure had been kept normal by the use of pilocarpine drops for a year, when glaucomatous attack occurred which would not yield either to conservative or operative treatment.

A transitory rise of intra-ocular pressure was noticed in eight cases and it was necessary to give miotics for a considerable time

(weeks to months) till the eye settled down and the intra-ocular pressure became normal, without any further use of drops. In three cases it occurred after intra-capsular extraction (0·66 per cent.), in all three it was associated with pupil disorders (vision 5/7, 5/7, 5/25). In five cases it developed after extra-capsular extraction (2·5 per cent.); in three of these there was a mild post-operative iritis (vision 5/7 in all three cases), in one case there was iris prolapse (vision 5/15), and in one case no cause was ascertained (vision 5/7).

In the remaining seven cases the raised intra-ocular pressure required permanent treatment with miotics or operation. It may be said that this group alone belongs to the so-called secondary glaucoma after cataract extraction. The distribution between intra- and extra-capsular extraction is two and five cases respectively, which corresponds to a relative frequency of 0·45 per cent. with intra-capsular, and 2·5 per cent. with extra-capsular extractions.

Intra-capsular cases showing raised intra-ocular pressure: (*a*) It was associated with elevation of the pupil (Case No. 13 p. 106). (*b*) It was associated with iris prolapse (Case No. 10, Table III).

Extra-capsular cases: (*a*) After prolapse of the iris (Case No. 1, Table III), (*b*) and (*c*) after elevation of the pupil (Case No. 12, p. 106, and Case No. 11, p 106).

CASE 15. (*d*) Woman, aged 31 years, traumatic cataract, extra-capsular extraction. Vision 5/7. With constant use of pilocarpine drops the intra-ocular pressure remained normal.

CASE 16. (*e*) Man, aged 81 years, extra-capsular extraction with complete iridectomy. Much lens matter remained in the eye, and mild post-operative iritis developed. Discharged 20 days after operation. Much vitreous haze was present, and the pupil was slightly elevated. Vision C.F. 3 metres, intra-ocular pressure raised, but miotics kept it normal.

There are no rigid rules in the treatment of secondary glaucoma. If eserine or pilocarpine has no effect, the newer miotics (doryl, mecholyl) may be tried. During a glaucomatous attack, intravenous injection of 50 per cent. glucose or hypertonic saline may reduce the intra-ocular pressure temporarily. After this treatment, the miotics may regain their effect on the eye, or if operation comes into consideration, it can be performed in the favourable period of low or relatively low intra-ocular pressure. The type of operation depends upon the condition of the eye. If, for instance, the secondary glaucoma is associated with subconjunctival iris prolapse it is advisable to perform cicatrisectomy, *i.e.* excision of the iris prolapse together with the surrounding scar-tissue. But in most cases cyclodialysis will be the operation of choice.

This series of cases shows that the post-operative increase of intra-ocular pressure is a serious complication, and confirms the generally accepted view that secondary glaucoma is far more frequent after extra- than after intra-capsular extraction.

Post-operative intra-ocular inflammation. Iritis, irido-cyclitis, kerato-iritis, endophthalmitis

Post-operative inflammations are responsible for the greatest number of losses after cataract extraction. In this series in about 25 per cent. of the inflammations the eye suffered seriously, and in about 8 per cent. the eyes were lost. Since the fate of the eye often depends upon the outcome of post-operative inflammation, it demands most careful treatment—even in the mildest cases.

Some authorities distinguish between post-operative infection and iritis etc. The clinical appearance may vary from the mildest ciliary flush, through various degrees of uveitis, to endophthalmitis, but from a pathological point of view the distinction between post-operative iritis and infection is certainly not justified. The mildest post-operative iritis may be, and mostly is, caused through infection which enters the eye during operation; on the other hand the severest form of endophthalmitis, even panophthalmitis, may be developed from a focus in the body, *e.g.* cystitis. In this paper therefore *all* post-operative uveal inflammations, without regard to their degree of severity, are dealt with collectively. This is all the more justified as their treatment is based on the same principles. Such a classification, if accepted, would enable us to compare the statistics of different authorities.

Operative trauma as the cause of true post-operative inflammation may be discarded. It may lead to hyperaemia of the iris which disappears in one to three days, and in some cases a drop of atropine is sufficient to dilate the pupil. But the majority of post-operative inflammations are caused by infection during or after the operation, and only in a fraction of the cases can foci or toxins be made responsible for it. The age of the patient has a certain rôle, and Halász has found that the incidence of post-operative inflammation increases with age, with the maximum frequency over the age of eighty.

In the development of this complication the procedure at operation plays an even greater rôle than in the increase of the intra-ocular pressure. The incidence after extra-capsular operation is far more frequent than after intra-capsular. A good explanation may be that the lens matter which has been left in the eye after extra-capsular extraction, is a very good nutritive medium for bacteria which may enter. Opinions are divided as regards the anaphylactic inflammation caused by lens matter.

Intra-capsular extraction as a prophylactic against post-operative inflammation is stressed in Meller's warning, who—though on the whole in favour of extra-capsular extraction—points out that post-operative inflammations are not so common after intra-capsular extraction. He advises therefore the intra-capsular extraction for cataract patients who have a stubborn conjunctivitis, resisting every kind of treatment.

It is very difficult to ascertain the causes of post-operative inflammation. Factors which might have some significance in post-operative inflammation were found in this series of cases: about 25 per cent. of the cases were diabetic (9 cases), and two patients had syphilis. Both these conditions reduce the patient's resistance towards infection. In some cases infected foci may act as a potential source of the inflammation. Cystitis was probably the cause in one case. The condition of the teeth does not seem to have much influence. In the majority of the patients the teeth were in a most unsatisfactory state and yet where there was post-operative inflammation, other causes than the teeth were more probable.

Local conditions which favoured the onset of infection were: rodent ulcer of the face in one case; after irrigation of the anterior chamber mild iritis developed in six cases which all reacted well to atropine drops, and if necessary, milk injection; in three cases it was found that inflammation developed after operations during which instruments were introduced into the eye many times—for instance in attempting to remove the capsule after extra-capsular extraction had been performed.

Forty cases of post-operative inflammations (6·2 per cent.) are recorded here. The average age of the patients was 67 years. The effect on the healing time was significant as shown by the number of hospital days. The average was 18·5 days, which is the longest healing time in all post-operative complications. The frequency of the incidence with intra-capsular operation was 2·6 per cent. and with extra-capsular 14 per cent., that is a ratio of more than one to five. And in cases of the most serious inflammations the ratio was one to eight. Vision: 5/5-5/15, 26; 5/25-5/50, 3; less than 5/50, 8; no P.L., 3 cases.

As has been said post-operative inflammation has the most serious consequences of all the complications, and as we learn most from our failures I give the following details.

CASE 17. (*a*) Woman aged 84 years, intra-capsular extraction with complete iridectomy. On the second day after extraction plastic iritis developed. For three days atropine, milk injection and large doses of salicylates were tried without much effect, then keratotomy brought the process to a standstill. The patient was dismissed 32 days after operation. The eye was white, perception and projection of light was good. In the pupillary area there was a thick membrane. The patient was told to come back for needling after some months, as the probability of useful vision after needling was good. She did not return.

CASE 18. (*b*) Man, aged 71 years. On the other side of the face there was a rodent ulcer, for which the patient refused operation. Before operation it was cleaned up as much as possible, and treated with disinfectants. The cataract extraction was intra-capsular, with complete iridectomy. Three days later some exudate appeared in the A.C. The inflammation settled down in 28 days, after vigorous treatment with salicylates and foreign protein. Vision C.F. 1 metre, much vitreous haze.

CASE 19. (*c*) Man, aged 50 years, extra-capsular extraction with complete iridectomy. Vitreous complicated extraction. On the third day symptoms of endophthalmitis appeared. After atropine, foreign protein treatment and keratotomy,

the inflammation settled down in 18 days. Vision C.F. 1 metre. The patient had cystitis.

There were in this series two tragic cases in which both eyes had severe post-operative inflammation.

CASES 20-21. (*d*)-(*e*) Man, aged 80 years, extra-capsular extraction with complete iridectomy. The healing was undisturbed so on the eighth day after operation the cataract of the second eye was operated upon. This was also extra-capsular with complete iridectomy. Two days later, *i.e.*, ten days after the first operation, there were symptoms of mild iritis in the first eye. A few days later the second eye was inflamed too, and in spite of all treatment the uveitis dragged on. It was interesting that apart from some haziness the aqueous was relatively clear. The iris was hyperaemic, thick and oedematous. Eventually, both eyes showed a clinical picture which was very similar to conglomerate tuberculous iritis. It took 75 days before the eyes settled down and the patient was able to leave the hospital. Phthisis of the globe developed in one eye which later had to be excised. Prof. Löwenstein (Staatl, Serotherap. Institut, Vienna) grew B. Tuberculosis from the globe. In the second eye vision was C.F. 1 m.

CASE 22-23. (*f*)-(*g*) The second patient was a woman, aged 62 years. The operation on the first eye was performed in 1935, extra-capsular extraction with complete iridectomy. The operation was a typical one without any complication. On the seventh day iritis appeared and gradually a deep keratitis set in. The eye settled down in eight weeks, and the cornea cleared up considerably. Vision 5/50. Six months later a new attack of iritis developed which ended in phthisis bulbi. The second eye was operated on in 1937. On the fifth day iritis developed the course of which was very similar to that of the first eye. In this eye, luckily, no phthisis of the eye developed. Dense corneal scars remained and vision was hand movements, perception and projection of light was good.

The post-operative inflammation of the second eye was unexpected as the patient was overhauled very carefully before the operation, with special attention to the existence of potential foci of infection. The pre-operative treatment, as well as the operation, was even more cautiously made than in routine cases. It is noteworthy that the post-operative inflammation of the two eyes was very similar in symptoms and outcome. Both eyes showed a deep keratitis which in itself is not frequently met with after cataract extraction. Another feature was the relatively late appearance of the inflammation—in one eye seven days, in the other five days after the operation. It is possible that this is one of those which have a tendency to post-operative inflammation, perhaps as the effect of some constitutional disorder.

CASE 24. (*h*) Woman, aged 49 years. Tumescent cataract which caused glaucomatous attack. The eye responded well to miotics, and the cataract operation was performed at a time when the intra-ocular pressure was practically normal. The A.C. was very shallow, and routine extra-capsular extraction with complete iridectomy was performed. Post-operative uveitis with deep keratitis developed, and in 16 days the eye settled down. Vision C.F. 1 m.

(*i*) See Case No. 16 p. 109.

CASE 25. (*k*) Woman, aged 71 years, diabetic. Extra-capsular extraction with peripheral iridectomy. Four days later mild ciliary injection developed which settled down in a few days. The patient was dismissed ten days after the operation. Subsequently a chronic, mild cyclitis was recorded; slight pains chiefly at night, but the eye was white and only slit-lamp examination showed some haze in the aqueous and a few active K.P. Treatment had practically no effect and six months later vision was C.F. 1 m., and intra-ocular pressure was very low.

In the following case, the post-operative inflammation did not cause any loss of vision as long as the general condition of the

patient was satisfactory, but the follow-up of this case has shown some interesting features.

CASE 26. (*l*) Man, aged 80 years, extra-capsular extraction with peripheral iridectomy. On the ninth day after operation the eye was somewhat painful, next day iritis developed which settled down in a further ten days. The patient received ultra short wave treatment and tophosanyl injections (atophan preparation). Vision 5/7. Two months later recurrence of the iritis took place, and at the same time painful swelling of both shoulders, and of elbow and wrist on one side. Aqueous was hazy and vision dropped to 5/50. In six days the iritis healed and vision was restored to 5/7. After another six weeks I was asked to see the patient who was seriously ill. The vision of the eye was lost. But this time, not iritis, but extensive retinal oedema of both eyes was responsible for the loss of vision. The patient had cardiac breakdown and a few days later he died.

In this case the post-operative iritis developed on the ninth day, and up to that time the healing was undisturbed. This points against an infection, and it seems probable that the two attacks of iritis and the painful swelling of joints were of the same origin.

Another question which arises here is how far the operation upon the eye was responsible for the deterioration of the general condition of the patient. Any operation at this age has its dangers, and before deciding upon a cataract operation, not only the eye but the possible effect on the general condition, should be taken into consideration. Harrison Butler pointed out in connection with glaucoma operations that sometimes the operation may be successful as regards the eye itself but the general condition of the patient suffers.

In this series of cataract operations there was no case of panophthalmitis.

Prophylaxis and Treatment.—The majority of post-operative inflammations are caused by infection, therefore asepsis must be strictly adhered to. It is also important that the operation should be performed gently and carefully so as to give rise to as little operative trauma as possible. Further, we have to consider the general condition of the patient, to make him as fit as possible before the operation, and to eliminate known infective foci. Finally, we have to bear in mind that post-operative inflammation is more frequent after extra-capsular operation, therefore, wherever possible the intra-capsular operation should be done.

For local treatment mydriatics (atropine, hyoscine, cocaine) and heat are employed. If local treatment is insufficient we must use other methods. In cases of persistent ciliary tenderness and pain during night, ultra short wave treatment has a good effect. But in severe cases ultra short wave irradiation is only a supplementary treatment, supporting other therapeutic measures, such as foreign protein therapy (milk, T.A.B. vaccine etc.), large doses of sodium salicylate may be used, sulphanilamide preparations, urotropine, atophan, etc.

Early and vigorous treatment is essential, but this alone in severe cases is not sufficient, and keratotomy together with cauterisation

of the lips of the wound may be useful. This operation is advisable in the severe forms of post-operative endophthalmitis, and suppurative uveitis where the A.C. contains much exudate. In these desperate cases a simple keratotomy would have practically no effect, as the A.C. fills with exudate again in a few hours. If the cautery is used, the A.C. will be drained for many days and the operation is easy to perform. Keratotomy is done in the lower part of the cornea, and after letting out the aqueous and exudate from the A.C., a Daviel spoon is inserted into the wound so as to protect the iris and the posterior wound lip. Then a small hole is burnt into the anterior wound lip of the cornea with a fine pointed galvano-cautery.

The resulting scar is very small, and is outside the pupillary area, so that it will not interfere with vision. In some of these cases where there was no response to other treatment and the condition of the eye showed steady deterioration, I had satisfactory results from this operation. In three cases the endophthalmitis stopped after the operation, and in one of them, where needling was performed later, the vision achieved was 5/10.

Strictly, thread infections spreading along the corneo-scleral stitch do not belong to the group dealt with in this section, but as they are infections it seems reasonable to include them here. In a series of 457 corneo-scleral stitches, only two infections were recorded. In both cases the stitch was removed as soon as the infection showed itself, and the small infiltrate of the conjunctiva disappeared in a few days. If necessary, the infiltrate may be touched with a fine pointed galvano-cautery.

Other complications

In two cases *retrobulbar neuritis* was recorded about a month after extraction.

CASE 27. (*a*) Woman, aged 66 years, long standing chronic benign glaucoma. extra-capsular extraction with complete iridectomy. Operation and healing were undisturbed, and the patient was discharged twelve days after operation. Vision 5/10. Five weeks later the patient complained of sudden loss of vision. Intra-ocular pressure was normal and no change in the retina or refractive media was found, but there was a large central scotoma. After administration of vitamins, amyl nitrite inhalation, and strychnine the vision was again 5/10 in 14 days. She was under observation for three years, the vision remained unchanged although the disc became pale.

CASE 28. (*b*) Man aged 78 years, intra-capsular extraction with peripheral iridectomy. Operation and healing undisturbed, except a minor degree of choroidal detachment which became reattached in 14 days. Vision 5/15 which was due to senile changes in the macula lutea. Four weeks later the patient noticed blurring of vision. There was no change in the fundus, but a large central scotoma was found. The patient received vitamins, acetyl-choline-chloride hypodermic injections, and local heat by means of diathermy. The vision was gradually restored to 5/15. The patient was observed for a year, vision was unchanged, but pallor of the disc developed.

The rhinological and neurological findings in both cases were negative.

Hyphaema.—All haemorrhages—even if only a trace—which appear during the healing period after cataract extraction belong to this group. The commonest cause of hyphaema is the reopening or rupture of the wound. In many cases only the interior wound edges are reopened and the wound is apparently undamaged. On the other hand haemorrhages may occur from blood vessels severed during the iridectomy, or from new capillaries growing into the wound.

The incidence of hyphaema after corneo-scleral stitch operations was double that observed after other methods of wound closure (20 per cent. resp. 10 per cent.). The majority of hyphaemas occurred 5-7 days after operation, and this was the time when the corneo-scleral stitch was usually removed.

TABLE IV

Days after operation ...	1-2	3-4	5-6	7-8	9-10	11-12	13-14
Haemorrhage in the A.C. in per cent.	15	17·5	26	24·5	12	3·5	1·5

Stallard found hyphaema in about 30-35 per cent. after cataract operations where no corneo-scleral stitch was used, whereas with the use of it, the incidence dropped practically to nil—in 107 consecutive cataract operations no post-operative hyphaema occurred. Stallard removed the stitch after 10-12 days, *i.e.*, after firm closure of the wound, and this may be the explanation of his good results. Recently, however, Ellett and others have found that the use of a corneo-scleral stitch had not fulfilled the hopes as regards post-operative hyphaema.

Most of the haemorrhages occurred into the A.C., and only in very few cases was vitreous haemorrhage associated with it. The prognosis of the hyphaema is generally good, and as a rule they clear up in a few days without any treatment. In rare cases, however, where absorption is slow or there is much blood in the A.C., keratotomy may be valuable. The absorption of vitreous haemorrhages takes a longer time, and it may be imperfect and vitreous floaters remain. This may cause permanent damage to vision. In this series one such case was recorded. There were some others where the vision was 5/5, yet vitreous floaters, probably through diffusion of light, caused the patient discomfort. Vitreous haemorrhage—contrary to haemorrhage in the A.C.—needs treatment, the aim of which is to accelerate its absorption. I have found that the combination of diathermy heating of the eye and large doses of iodine often give a good result. I have also tried vitamin C without any benefit to the patient.

Comment and Summary

In the *first part* of this paper, statistical analysis of the *whole mass* of operations has shown that the method of wound closure has a significant influence upon the duration of the healing period. Experience with three different methods of wound closure—all widely used—has clearly proved that the shortest healing time follows the use of a corneo-scleral stitch. The difference in the time of healing between the conjunctival flap and Kuhnt's apron, and between Kuhnt's apron and corneo-scleral stitch operations, is about 10 per cent. From this it can be seem that a considerable saving in nursing expense may be effected and that the patient can return to normal life earlier.

The corneo-scleral stitch is valuable where circumstances require rapid closing of the wound, as for example in cases of any complication during operation. Besides this the stitch gives protection against the reopening or rupture of the wound, and should a wound rupture take place the consequences are milder.

In the *second part* of this paper an account is given of *each individual case* in which complication occurred during or after the extraction. Analysis has shown that:

After vitreous complicated extractions the damage suffered by the eye was slight. This generalisation, of course, is not valid in case of excessive loss of vitreous.

The incidence of prolapse of the iris and of the pillars of iris colobomata after extra-capsular extraction was about twice that following intra-capsular extraction. The treatment of prolapse of the iris should be immediate reparative operation, in which case the prognosis is relatively good. Subconjunctival iris prolapses, which develop weeks or months after the extraction, are serious, and treatment consists in excision of the prolapse and adjoining scar tissue.

Elevation of the pupil or of the pillars of colobomata or irregularity in the shape of the pupil, after vitreous complicated cataract extractions, causes no damage to the eye, while in those cases which occur after uncomplicated extractions, the pupil disorder was followed by increase of intra-ocular pressure in about half the cases.

Among the serious cases of secondary glaucoma following extra- and intra-capsular extraction the ratio was five to one.

In desperate cases of post-operative inflammation the ratio in favour of intra-capsular extraction was eight to one.

Secondary glaucoma and post-operative inflammation take the heaviest toll after cataract extraction, and the best means of avoiding them seems to be to employ intra-capsular extraction. Although the reputation of this operation is steadily increasing there

are many who favour the extra-capsular method. It is true that the latter is somewhat easier to perform, but the intra-capsular extraction is not a difficult matter for an experienced operator. It has often been stated that with intra-capsular extraction vitreous complications are more frequent. But, even if it were so, since vitreous complications are so much less serious than was formerly believed this argument loses much of its validity. Moreover, as stated above, there is a considerable divergence of opinion on this question.

Another weakness of the extra-capsular method is that a second, and sometimes a third, operation may be necessary. Davenport gives account of 2,368 extra-capsular extractions, and in 1,479 cases needling had to be performed. Apart from the difficulties and discomfort of a second operation, it must be remembered that needling is not free from dangers and complications, and even losses may occur after it.

All the above considerations point to the value of reinforced wound closure by means of a deep suture, and to the superiority of the intra-capsular method. Improvement in the technique of the intra-capsular extraction has made it applicable to all but a very limited number of cases, and full use should be made of it.

REFERENCES

ARNDT, E. W, (1940).—*Brit. Jl. Ophthal.*, Vol. XXIV, p. 182.
BARRAQUER, J. (1939).—*Ann. d'Ocul.*, Vol. CLXXVI, p. 470.
BUTLER, H. (1939) —*Trans. Ophthal. Soc. U.K.*, Vol. LIX, p. 4.
BUXTON, R. (1939).—*Brit. Jl. Ophthal.*, Vol. XXIII, p. 505.
DAVENPORT, R. C. (1928).—*Brit. Jl. Ophthal.*, Vol. XII, p. 89.
ELSCHNIG, A. (1939).—*Zentralbl. f. d. ges. Ophthal.*, Vol. XLIII. p. 321.
GIFFORD, S. R. (1940).—*Arch. of Ophthal.*, Vol. XXIII, p. 301.
GREENWOOD, A. and GROSMAN, H. B. (1935).—*Trans. Amer. Ophthal. Soc.*, Vol. XXXIII.
HÁLASZ, K. (1935).—*Szemészet*, p. 155.
HILDING, A. (1939).—*Arch. of Ophthal.*, Vol. XXII, p. 171.
KLEIN, M. (1939).—*Trans. Ophthal. Soc. U.K.*, Vol. LIX, p. 293.
KNAPP, A. (1936).—*Arch. of Ophthal.*, Vol. XVI, p. 770.
MELLER, J. (1938).—Augenärztliche Eingriffe.
POST, L. T. (1939).—*Amer. Jl. Ophthal.*, Vol. XXII, p. 1162.
DE SAINT MARTIN, R. (1935).—L'extraction capsulolenticulaire de la cataracte.
——— (1940).—Modern Trends in Ophthalmology.
SINCLAIR, A. (1932).—*Trans. Ophthal. Soc. U.K.*, Vol. LII, p. 57.
STALLARD, H. B. (1938).—*Brit. Jl. Ophthal.*, Vol. XXII, p. 270.
WAGENER, H. P. (1937).—*Amer. Jl. Ophthal.*, Vol. XX, p. 253.
WRIGHT, R. E. (1937).—*Amer. Jl. of Ophthal.*, Vol. XX, pp. 1, 119, 240, 376.
V. SOLT, K. (1937).—Statistical Methods in Medicine. Budapest.

INVESTIGATION CONCERNING THE LENS CAPSULE

Its importance in the technique of intra-capsular cataract extraction

BY

M. KLEIN

LONDON

IN a previous paper, p. 93, I reviewed the cataract operation, and especially the complications, their frequency and consequences, and arrived at the conclusion that the intra-capsular method is superior to the extra-capsular. I now propose to examine the anatomical and physiological aspects of intra-capsular extraction.

The two delicate phases of an intra-capsular extraction are the dislocation of the lens, and its removal from the eye. Many authorities think that the success of the operation depends entirely upon the strength of the lens capsule in relation to that of the zonule. If the strength of the capsule be greater than that of the zonule, the latter gives way first and the cataract can be removed in the capsule. But when the zonule is stronger than the lens capsule, the capsule opens and only extra-capsular extraction is possible.

This problem is, however, not so simple, and if it is to be completely understood we have to know the finer anatomy of the capsule and zonule, their relation to the vitreous, their physical properties, especially their strength, and finally the changes which occur in these structures in cataractous eyes. Knowledge of the anatomy and physiology of the lens capsule and zonule will help us to appreciate the technique necessary for the operation, as well as the precise rôle played by each instrument.

The lens capsule proper, like Descemet's or Bowman's membrane, is structureless and elastic. Some specimens show striations, which run parallel to the surface and are regarded by some authorities as signs of a lamellar structure. Sometimes, indeed, it is possible to break up the capsule into lamellae by treatment with a solution of pot. permanganate, or 10 per cent. sodium chloride. O. Schulze and O. Becker regard the lamellar structure as a senile change. Normally the lamellae are so firmly cemented together that the lens capsule may be regarded as a homogeneous membrane, and lamellarization takes place only in pathological conditions (E. E. Blaauw).

The lamellae must not be confused with the zonular lamella, which is a very thin and elastic membrane covering the peripheral

parts of the anterior lens capsule, which can easily be separated from it. The zonular fibres are attached to the zonular lamella, and not to the lens capsule proper.

The thickness of the lens capsule is not uniform. The posterior capsule is thinner than the anterior, and in both the central area

FIG. 1.

(From Duke-Elder Textbook, Vol. I. After Fincham.)

(anterior and posterior pole) is thinner than the rest. The maximum thickness of the capsule lies between the equator and the centre concentrically.

The thickness of normal capsules varies with age (Table I, after Salzmann).

The zonular fibres form a meshwork between lens and ciliary body and they arise from the whole area of the ciliary body. The

TABLE I

Thickness of the normal lens capsule in μ after Salzmann

No.	Age	Anterior pole	Maximum of anterior capsule	Equator	Maximum of posterior capsule	Posterior pole
1	14 days	6	8	3	18	2·5
2	2½ years	8	12	7	18	2
3	7 years	8	13	9	17	2
4	9 years	8	15	8	22	2
5	15 years	9	14	14	23	3
6	19 years	12	23	17	26	3
7	23 years	11	18	14	21	3
8	26 years	10	18	10	17	3
9	32 years	12	16	16	21	2·3
10	35 years	14	21	17	23	4
11	36 years	9	21	16	22	3·4
12	40 years	16	22	16	18	3
13	41 years	11	18	18	23	3
14	48 years	11	22	15	28	3·4
15	53 years	14	25	16	23	3
16	56 years	18	23	14	16	3
17	71 years	14	21	9	9	2·3

shorter fibrils coming from its anterior parts pass straight to the lens through the posterior chamber. The longer ones which come from the back of the ciliary body are applied firmly to the vitreous or are embedded in it. On the lens they are attached to the zonular lamella which, as already mentioned, occupies a ring-like area concentric with the equator. The length of the fibres varies, the longest, in adults, may reach a length of 7 mm., the thickness is between 9 and 30 μ, very rarely 40 μ. The thick fibres split up at their two ends into thinner branches. The fibres are not elastic and when relaxed they show no tendency to curl but bend at sharp angles. When stretched they will lengthen considerably before breaking. With avancing age the zonular fibres show certain changes. In young subjects they are very tough, and experiments on young animals have shown that stretching of the zonular fibres may damage the vitreous and ciliary body. In old people the zonular fibres become fragile to such a degree that in cases of senile retraction of the vitreous body the zonular fibres may sometimes be severed spontaneously.

In cataractous eyes both zonule and capsule undergo certain changes. The lens capsule gets thicker. Rötth and Klein have found that capsules of intra-capsularly extracted lenses are considerably thicker than normal ones of corresponding age.

As Table II shows, the *minimum* values of cataractous lens capsules were about the same as the average normal in Salzmann's figures. Cataractous lens capsules are much thicker than normal. The low figures obtained after celloidin paraffin embedding are probably due to shrinkage during preparation.

TABLE II

Thickness of cataractous lens capsules in μ after Rötth and Klein

	Anterior pole	Maximum of anterior capsule	Equator	Maximum of posterior capsule	Posterior pole
Gelatine method –					
Average	24	30	12	10	6
Maximum	32	35	20	22	15
Minimum	12	23	5	6	2
Celloidine - Paraffine method—					
Average	10	15	7	5	2
Maximum	17	21	10	9	4
Minimum	4	6	3	2	1

The changes in the zonular fibres in cataractous eyes consist of diminution of their resistance, with relative increase in their fragility.

The anatomical aspect, however, is not sufficient for the complete understanding of the problem, as it does not give information as to the tensile strength of the capsule and zonule, whether, that is, the thickening of the capsule in cataractous eyes is accompanied by an increase of its strength. In intra-capsular operation success depends on the strength of the capsule, it should not give way during operation. Examination of the tensile strength of the capsule, *i.e.* how great a force is necessary to break it, is a delicate problem.

The only data to be found in the literature about the strength of the capsule are those by Pflugk, who found that in normal human lenses a strip of one millimetre width, cut from the middle parts of the posterior capsule, broke under a pulling force of 1 gram. If a 1 mm. wide strip of the anterior and posterior capsule were tested together the breaking weight was 6-8 grams. Similar values were obtained in lens capsules of pigs' eyes. This correspondence between human and pigs' lens capsules is not surprising, as other tissues of the eye are also similar. In comparative tonometric experiments by Leimke, and distensibility experiments by Ridley, human and pigs' sclerae showed great parallelism. According to Pflugk the breaking point of cataractous lens capsules was below normal, and two grams weight was sufficient to break them when anterior and posterior capsules were tested together.

The method used in Pflugk's experiments was as follows: he cut strips from the middle part of the lens capsule one and two millimetres wide, the tensile strength of which was tested with an apparatus designed for testing the elasticity and tensile strength of threads in the textile industry. This apparatus is very elaborate and gives reliable figures as far as threads are concerned, but for lens capsules (either in whole or part) the method of examination is open to criticism. We have to bear in mind that the lens capsule, the anterior as well as the posterior, is a segment of a sphere, and even the narrowest strip cut from a spherical surface can never be flattened into a plane. If we put into the apparatus a strip of the lens capsule and expose it to a pulling force acting at the two ends of the strip, the distribution of the pulling force will be uneven and thus the figures obtained do not give the true strength of the capsule. Since, however, all these experiments of Pflugk were made in a similar way the error is the same all round and we can accept his conclusion that the tensile strength of the cataractous lens capsule is diminished.

The author's investigation of the strength of the capsule.—It is an important condition in these experiments that the testing

force should be exerted uniformly over the whole area of the capsule. The technique was as follows: The lens capsule (ox eye, pig's eye and human cataractous lens) was very carefully removed from the lens. First a circular incision was made at the equator with a sharp Graefe's knife, after which the anterior capsule was easily removed with the finger tip or a blunt capsule forceps. The lens capsule was then fastened to the end of a piece of glass tubing, the edges of which were rounded. The thread (thick sewing silk) used for tying the capsule to the tubing had to be carefully applied, the capsule being delicate and easily damaged. The glass tubing used with ox lenses had a diameter of 8 mm. (inner diameter 5 mm.), in tests on human and pig's lenses the tubing had an external diameter of about 4·5-5 mm., inner diam. approximately 3 mm. The free end of the tubing was then connected with a system in which the pressure could be increased or diminished (blowing or suction) and the pressure + or — read on a manometer. The manometric reading at the moment when the capsule burst was taken as a measure of the strength of the capsule. For breaking the anterior capsule of ox lenses the figures varied between 1-2·5 atm. pressure. Normal pigs' lenses could withstand a pressure or suction of 500 mm. Hg without breaking. I had no opportunity of examining normal human lenses, but we may assume that the strength is near to that of pigs' lenses. I have tested cataractous human lens capsules, obtained by intra-capsular extraction. Their breaking point was about 150-200 mm. Hg pressure. In these experiments the stress on the capsule was more uniformly distributed than in Pflugk's experiments as in both experiments, pressure and suction the lens capsules took up a spherical shape.

These experiments give some idea how strong this thin and delicate membrane is, and indicate how great a strain it can withstand before giving way. The strength of the cataractous lens capsules is less than that of a normal, but it can resist a considerable strain.

As regards the strength of the zonule, Pflugk had found; in the case of a 1-2 mm. wide strip cut from the zonular network, that the breaking point was at one gram weight. This method of testing the zonule is, however, even more open to objection than his experiments on lens capsules, as the conditions under which the experiments took place were entirely different from those in the living eye.

The conditions in Barraquer's experiments are much closer to those in the eye. He found that at the age of 40 years a 30 gram weight was necessary to break the zonule. The resistance of the zonule diminishes with age, and this is also the case in cataractous eyes. According to Barraquer the zonules of myopic eyes are more fragile than those of hypermetropic eyes.

The relation between lens and vitreous is also very important. If it were true, as suggested by some authorities, that adhesions between lens and vitreous are frequent, intra-capsular extraction would lead inevitably to vitreous loss. In slit-lamp examinations, however, De Saint Martin found that a narrow retro-lental space was present between vitreous and lens in 84 per cent. of adults. The absence of adhesions between lens and vitreous in the great majority of cases makes it possible to perform intra-capsular cataract extractions without damage to the vitreous, and this is confirmed by experience.

The preceding considerations show that the conditions in the cataractous eye are generally favourable for intra-capsular extraction: the capsule is comparatively tough, the zonule fragile, and the lens can be removed without damage to the vitreous.

From a practical point of view the intra-capsular operation has two phases, (1) dislocation of the lens, *i.e.* severing the connection between lens and zonule, and (2) the removal of the loose lens from the eye. In the forceps intra-capsular operation, the first phase, *i.e.* the dislocation of the lens, is done by forceps and squint hook. A small fold on the capsule is gripped with forceps and by careful traction and rotation movements the zonule is *gradually* broken. It is, perhaps not correct to speak of breaking or tearing of zonular fibres, as in most cases of intra-capsular operation the zonule is separated with the zonular lamella. This may be the reason why adherent zonule fibres are rarely found on lenses after intra-capsular extraction.

The separation of the lens from the zonule requires delicate manipulation. By means of a capsule forceps a fold is grasped at the lower part of the anterior capsule (tumbling method), and by pulling the lens in a certain direction the zonule fibres become stretched in the corresponding section. The sclera at the limbus is now impressed over the stretched zonule by means of a squint hook, thus the stress on the zonule fibres is increased. This additional stress together with the traction exerted with the forceps is usually sufficient to break the zonule. If the direction of the traction is for example 7 o'clock, the impression of the limbus is to be made at the same place.

The same procedure is then repeated in different directions so as to separate section by section the zonule from the lens.

Sometimes it may be necessary to combine the traction with a gentle rotation movement.

If the lens is so loose as to move quite freely with minute and cautious manipulation of the capsule forceps, then the second phase of the operation begins, namely the removal of the lens from the eye.

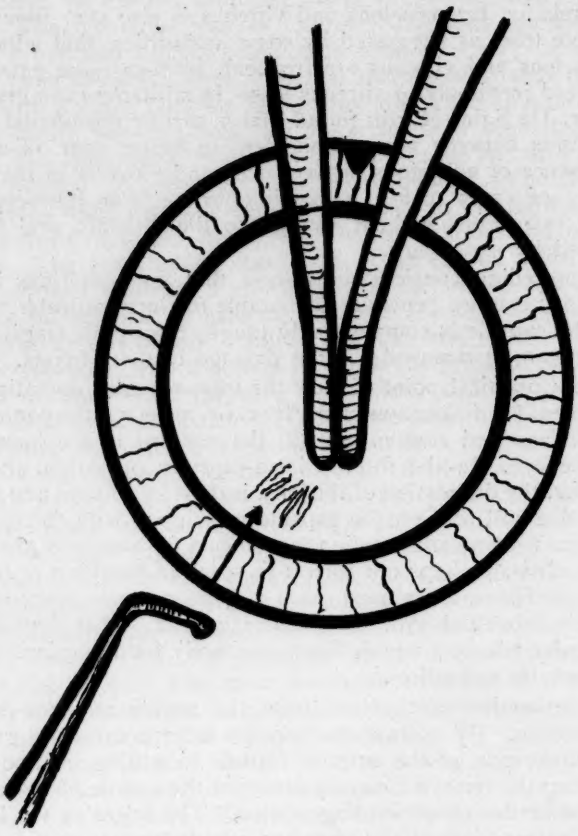


FIG. 2.

The arrow indicates the direction of the traction with forceps. Stretched zonule at VII o'clock. Impression with squint hook at VII o'clock.

The normal position of the lens is in the patellar fossa of the vitreous, and between lens and vitreous there is only a very narrow space, filled with liquid. The extraction of the lens must be done very slowly and gently. If the lens were removed abruptly, by a sudden movement, vitreous prolapse would almost certainly follow, on account of physical adhesion between lens and vitreous. The lens is, so to speak, slid out from the patellar fossa by adroit manipulation of traction and impression movements with capsule forceps and squint hook. When the lower edge of the lens has

been lifted up to the height of the middle of the cornea, there is no need to use any more force. We may abandon the capsule forceps and rely entirely on gentle pressure with a hook, or—as practised by some authorities—the capsule forceps alone may be used without the help of the hook.

There are some technical points which are of importance. The most uniform pull is achieved by the sucking cup methods (Barraquer etc.). It is perhaps this which accounts for the higher percentage of successful intra-capsular operations as compared with the forceps method.

In the forceps method it is important that the forceps should be opened only to 3-4 mm. as otherwise the fold, made by the grip of the forceps, would be large and the capsule becomes overstretched in certain directions. This may lead to bursting of the capsule. When the fold is relatively small the risk of overstretching is eliminated.

Much depends also upon the instruments used. If for example the edges of the capsule forceps are sharp it will cut the capsule instead of gripping it; on the other hand if it is too blunt it may slip off and difficulty may be experienced in getting a grip on the capsule.

The skill and practice of the surgeon is obviously an all important factor. With growing experience, the proportion of successful intra-capsular extractions will increase. In Halász' paper the rôle of experience is well demonstrated. At the I. Univ. Eye Clinic, Budapest, in the years 1930-32, when intra-capsular operation was introduced, only 42 per cent. of the attempted intra-capsular operations were successful. In the next two years the figure rose to 51 per cent., and with increasing experience the successful intra-capsular operations in the following year reached the figure 69 per cent.

This figure corresponds with the good average, varying from 60-75 per cent., experienced by different authorities. It appears that about 75 per cent. is the limit which can be expected at present by forceps intra-capsular extraction. Improvement can only be hoped for from new methods of operation. De Saint Martin and others employ the suction cup-forceps combined method. The experiments concerning the strength of the lens capsule, described in this paper, support this combined method, as the suction cup gives a more uniform traction on the capsule than the forceps. But apart from this consideration there are other reasons for the higher percentage of success with the suction cup method. There are some types of cataracts for which the suction cup method is suitable, which are unsuitable for the forceps method. For instance in cases of tumescent cataracts or certain hypermature cataracts, where the forceps slip off, the suction cup can easily get a grip.

In some instances the capsule may be fragile and the forceps, even with the gentlest handling, are liable to tear the capsule, whereas with the suction cup method a firm hold can be obtained without risk of rupture.

In the suction cup-forceps combined method the separation of the lens from the zonule is done by the suction cup. When the lens is loose, the suction cup is removed, and the extraction is completed by forceps and squint hook.

Whether this combined method is the cataract operation of the future, only clinical experience will decide.

REFERENCES

BLAAUW (1941).—*Arch. of Ophthal.*, Vol. XXV, p. 12.
DIMITRY, T. J. (1939).—*Amer. Jl. Ophthal.*, Vol. XXII, p. 416.
DUKE-ELDER, S.—Text-book of Ophthalmology, Vol. I.
EISLER, P. (1931).—*Kurzes Handbuch d. Ophthal.*, Vol. I.
RÖTTH, A. and KLEIN, M. (1930).—*Klin. Monatsbl. f. Augenheilk.*, Vol. LXXXIV, p. 823.
DE SAINT MARTIN, R. (1940).—Modern Trends in Ophthalmology.
WOLFF, E (1940).—Anatomy of the Eye and Orbit.

A CASE OF CONJUNCTIVAL IMPLANTATION CYST FOLLOWING OPERATION FOR DETACHMENT OF RETINA

BY

J. R. ASCOTT, M.B., B.S.

M.O., QUEEN MARY'S HOSPITAL, ROEHAMPTON

History.—Male. Age 33 years. November 12, 1940, knocked down by a lorry, unconscious for a few minutes, no immediate ocular symptoms.

About four days later noticed a grey haze over the right eye; this gradually became worse until at times the eye was practically blind.

About four weeks after the accident he reported sick, and detachment of the retina was diagnosed.

December 23, 1940, operation for detachment of retina. No improvement of vision followed. About three months later his wife noticed a swelling under the R. lower lid, and this slowly increased in size during the next few months, not producing any symptoms.

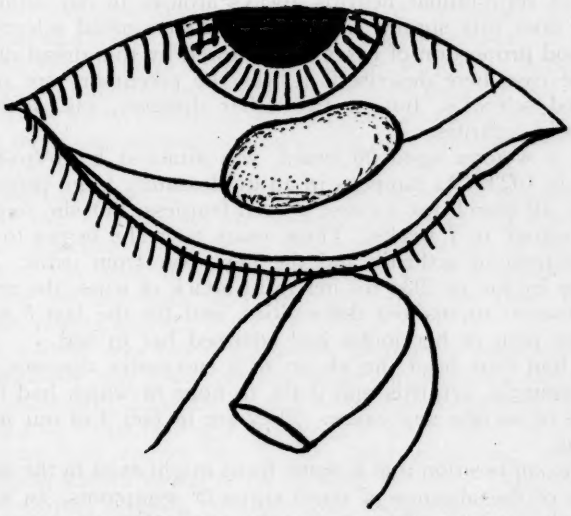
Condition on examination.—August 29, 1941. R.V.: P.L. with —7·0 D. sph. H.M. at 3 metres in lower field. L.V.: 6/18 with —1·25 D. sph. 6/6.

In the middle of the right lower fornix there was a cystic swelling under the conjunctiva, containing clear fluid with a deposit of opaque yellow material at the bottom. The cyst measured approximately 5/16 in. horizontally and 3/16 in. vertically, and projected sufficiently to cause a definite fullness of the right lower lid.

The right fundus was clearly seen. The retina was *in situ* throughout except for a narrow zone of doubtful detachment adjacent to the atrophic scar over the area of diathermic application at the periphery below. A slightly pigmented curved line passing from the disc, horizontally, above the macula, probably indicated the " high water mark " of the old detachment. Macular degeneration had probably followed the detachment.

Operation.—October 10, 1941. Local anaesthesia. The conjunctiva covering the cyst, with the exception of a small adherent area, was reflected downwards as a flap, and the cyst gently freed by blunt dissection. It was found to be slightly adherent to the sclera from which it was freed by sharp dissection, during which it was punctured. After removal of the cyst, the deepest part of which extended to the insertion of the inferior rectus, an unabsorbable suture was found in this region and was removed. The conjunctival flap was sutured in position.

Pathological Report.—The section shows conjunctival epithelium; beneath this, surrounded by fibrous tissue, is the implantation cyst, lined with epithelium similar to that of the conjunctiva. The



Lower lid everted, showing cyst in lower fornix.

contents consist of red cells, a few scattered nucleated cells, and material retaining only the ghostlike form of cells.

Conjunctival implantation cysts are comparatively rare. Although in this case the cyst was found in the region of a rectus tendon suture, it is thought to be unconnected with this; the implantation of conjunctival epithelium probably occurred while a conjunctival suture was being drawn from without inwards. As a suture is being drawn through, the conjunctiva tends to drag unless it is steadied, and it is suggested that it should be held near to the entrance of the suture, and kept on the stretch, to obviate this drag as much as possible.

I am indebted to Mr. Humphrey Neame, under whose care the case was admitted, for help with this report, and to the Director General of Medical Services, Ministry of Pensions, for permission to publish it.

THE DIAGNOSTIC SIGNIFICANCE OF RETRO-BULBAR NEURITIS

BY

ROSA FORD

LONDON

A CASE of retro-bulbar neuritis always arouses in our minds the query " does this signify the onset of disseminated sclerosis?", for a good proportion of cases are followed by this dread disease.

In the case here described, it was the precursor, not of disseminated sclerosis, but of two other diseases, viz. iritis and rheumatoid arthritis.

F.T., a woman aged 20 years, was attacked by retro-bulbar neuritis in 1923. As happens in an unpleasantly large percentage of cases, all search for a cause proved fruitless, but she recovered spontaneously in 7 weeks. Three years later she began to suffer from rheumatoid arthritis and the next year from iritis. When first seen by me in 1931 for her third attack of iritis, the arthritis had advanced to marked deformities, and for the last 5 months the acute pain in her joints had confined her to bed.

F.T. had thus been the victim of 3 successive diseases, retro-bulbar neuritis, arthritis and iritis, to none of which had it been possible to ascribe any cause. They are in fact 3 of our medical problems.

On the supposition that a septic focus might exist in the sinuses, in spite of the absence of nasal signs or symptoms, an attempt was made to drain them. By the application of argyrol and

glycerine to the nasal cavities, an immediate response was obtained in a flow of mucus, changing in 3 weeks to the discharge of small lumps of muco-pus. The iritis, which had lasted for 5 weeks, promptly cleared and the arthritis was brought to a standstill, with freedom from pain, in 3 weeks. F.T. was soon able to leave her bed and later to travel in a car without pain.

A septic focus in the sinuses, responsible for both iritis and arthritis, was thus demonstrated. While this had remained unsuspected and untreated, it is not surprising that none of all the usual remedies for arthritis had succeeded in relieving her or checking the progress of the disease, even though these had been tried for 5 years.

It seems somewhat startling, nevertheless, to find that the pain, which had lasted 5 years and during the past 5 months had been acute enough to confine her to bed, could cease in so short a time as 3 weeks. We have followed so many hopeful clues in rheumatism, only to find them end in disappointment, that when we finally light on a real clue, we can hardly believe that we have arrived. Yet, logically, when the actual cause of the disease is being eliminated, we would expect just what did happen.

The result points the moral that we need some means of discovering the existence of *closed* sinusitis other than those in ordinary use. This is more particularly the case when the sinusitis is in an earlier stage, causing mainly local symptoms, before it has broken bounds and, by infecting the blood stream, has become a potential danger to any organ or part of the body.

It is at this stage, that is when it is causing retro-bulbar neuritis, that the case is seen by the ophthalmic surgeon. When, as in this case, rhinological examination finds the nose normal, we must beware lest we be like those who suppose, as George Eliot puts it, that " there was nothing behind a barn door because they couldn't see through it."

In previous papers, [3, 4] and [5] I have shown that the ophthalmic surgeon can look behind the closed doors by taking the *fields of vision*. The contracted fields reveal the activities of the hidden exudation deprived of its normal exit. This is confirmed by the widening of the fields and the restored sight when drainage becomes re-established.

This patient was too ill to permit perimetric examination and the diagnosis was made, as can often be done, by the *history*. Three successive diseases, known to be due sometimes to sepsis, pointed to a focus of origin somewhere in the body. As no such focus had been found, the sinuses were suspected, since here infection is known to linger on for long periods. They are moreover constantly open to infection from influenza, colds, the exanthemata etc. That this infection can remain completely hidden for

months or years has been reported.[1-5] Its existence in this patient was confirmed by the results of treatment.

The diagnosis was made when the patient was 28, *i.e.*, 8 years after the retro-bulbar neuritis. Had it been made at 20, when the disease was still localised, it seems clear that there need have been no arthritis and no iritis.

The early recognition of sinusitis at this stage thus gives to the ophthalmologist a rôle in the prevention as well as the cure of disease which the absence of nasal signs and symptoms denies to the rhinologist. It gives also to retro-bulbar neuritis a diagnostic significance in the aetiology of later disease.

Summary

A five weeks iritis promptly cleared and an acute rheumatoid arthritis which had steadily advanced for five years, was brought to a standstill in three weeks by drainage of the para-nasal sinuses.

The absence of nasal signs and symptoms had prevented earlier recognition of the sinus disease, and the case thus shows the need for other methods of diagnosing *closed* sinusitis than those in ordinary use. One such means is provided by the fields of vision.

The earlier retro-bulbar neuritis, when the sinus disease was causing mainly local symptoms, was a danger signal. Recognition of this signal in other cases, will give to the ophthalmologist a rôle in the prevention as well as in the cure of disease, and to retro-bulbar neuritis a diagnostic significance in the aetiology of other diseases.

REFERENCES

1. VAN DER HOEVE.—*Arch. of Ophthal.*, p. 214, 1922.
2. SIR ST. CLAIR THOMSON.—*Proc. Roy. Soc. Med.*, 1926 (*Section Ophthal. and Laryng.*, p. 85).
3. ROSA FORD—*Proc. Roy. Soc. Med.*, 1931 (*Section Ophthal.*, pp. 35-40).
4. ROSA FORD.—*Trans. Ophthal. Soc. U.K.*, pp. 507-518, 1933.
5. ROSA FORD.—*Brit. Jl. Ophthal.*, February, 1942.

ANNOTATION

Ophthalmological Notes and Queries

A letter from Mr. Francis E. Preston under the above heading was published in our January Number (p. 42). The question of reserving a portion of the Journal for short case reports has been discussed by the Editorial Committee on more than one occasion

during the past few years, and it has usually been considered that the possible advantages may be outweighed by the possible drawbacks. While it is a comparatively easy matter, in a spasm of enthusiasm, to set such a venture going, it often happens that after a few issues the scheme dies of inanition. In fact we should say that new schemes of this kind were peculiarly liable to sudden death. So far we have judged it best to go on as we have done in the past, publishing short case reports among the original communications. The present time, with its scarcity of paper, is hardly a suitable one in which to lock up even a few pages in this way. Short queries can easily find a home among the "notes" and if any are sent to us we shall be glad to consider their publication; but we should prefer not to have to turn ourselves into a sort of ophthalmological brains-trust, at any rate at present.

In less responsible publications such a question and answer scheme can be made most amusing. We call to mind a short article in a hospital gazette nearly forty years ago in which the extremely versatile editor propounded a scheme of this sort on payment of a small fee. He went on to say that his advertisement of the scheme produced only a single question. This was "how can I prevent my hair from falling out? signed, Alopecia Areata Biggs." This query he professed to have submitted to certain members of the honorary staff and in their replies burlesqued the foibles of each in lectures and demonstrations. Mr. Sheild's impressive speech on the difficulties of treating such cases in private practice was an excellent piece of mimicry, and Sir Humphry (then Dr.) Rolleston's encyclopaedic knowledge of the literature was fully worked out. One of the surgeons attributed a recurrence of baldness in one of his patients to the fact that the case had been treated by his house surgeon, a favourite device of his; and Mr. Frost's explosive utterance was caricatured in the following sentence: "horse exercise and eye outpatients; I have not lost a hair for years." To appreciate this it must be stated that Mr. Frost had been almost completely bald since he was a house-surgeon.

We tremble to think that the sober pages of the British Journal of Ophthalmology should be made the vehicle for caricaturing the leaders of our branch of the profession in this way. It might be made amusing, but the present writer certainly has not sufficient versatility to achieve it, nor would the Editorial Committee sanction it.

ABSTRACTS

MEDICAL OPHTHALMOLOGY

(1) **Smelser, G. K. (New York).—The rôle of the cervical sympathetic ganglion and Müller's orbital muscle in experimental exophthalmos.** *Amer. Jl. Ophthal.*, Vol. XX, p. 1201, 1939.

(1) **Smelser's** animal experiments inducing exophthalmos by the injection of extract of pituitary gland (thyrotropic hormone) have revealed the following facts. That all the orbital contents except the ventral lacrymal gland increased in weight. The orbital fat hypertrophied and this and the connective tissues and extra-ocular muscles became oedematous and infiltrated with lymphocytes. Of all the orbital tissues the fat and connective tissue underwent the greatest relative increase in volume and weight. Exophthalmos persisted post-mortem and the changes in the orbital tissues and in the degree of exophthalmos were quite unaffected by removal of the cervical sympathetic ganglia and the excision of Müller's unstriped muscle tissue. It is evident from Smelser's experiments that the active constituent of the pituitary extract (thyrotropic hormone) does not act through the cervical sympathetic, nor on the sympathetic receptor substance nor on the smooth-muscle cells.

Orbital decompression in these experiments did not relieve the condition of the orbital tissues but slightly decreased the degree of exophthalmos.

H. B. STALLARD.

(2) **Meyer, S. J.** and **Okner, H. B. (Chicago).—Dysostosis multiplex with special reference to ocular findings.** *Amer. Jl. Ophthal.*, Vol. XXII, p. 713, 1939.

(2) **Meyer** and **Okner** describe the case of a female child, aged 7 years, suffering from dysostosis multiplex. Among the more obvious skeletal deformities were the following. A broad, saddle nose, poor dentition (16 teeth in all had erupted), a shortened cervical spine which gave the appearance of the head resting directly on the shoulders, curvature of the spine, flaring and blunting of the distal ends of the clavicles and ribs, impaired flexion and stiffness of the fingers, genu valgum, a duck-waddling gait, congenital heart disease, impaired hearing, and a prominent abdomen. The general appearance of the child suggested both cretinism and achondroplasia. Her intelligence was apparently not below normal. Radiographs of the skull showed an increase in the antero-posterior and the lateral measurements of the sella

turcica, and a foamy trabeculated appearance of the short broad phalanges of the metacarpals and metatarsals.

At the age of 3 years vision was said to be defective after mumps. When the authors examined the child at the age of 7 the right vision was counting fingers at 6 feet and left vision was perception of light. The cornea was so hazy that details of the iris, pupil and anterior lens capsule could not be made out. The corneal diameter was 14 mm. and the authors comment that megalocornea had not been mentioned hitherto in the literature about dysostosis multiplex. There was no evidence of congenital hydrophthalmos.

Slit-lamp examination showed that the superficial layers of the cornea were flat and regular. Bowman's membrane and the substantia propria showed many punctate greyish white opacities; some of these had coalesced into small threads and plexiform masses.

H. B. STALLARD.

(3) **Nastri (Rome)** and **Basile (Naples).—A rare case of primary tumour of the optic papilla. (Su di un raro caso di tumore primario della papilla ottica).** *Boll. d'Ocul.*, Oct. 1939.

(3) **Nastri** and **Basile** give the history of a very unusual case; the subject, a man aged 47 years, on October 9, 1930, suffered a blow on the right supraciliary region, which made him lose consciousness. He noted some days after that he could not aim satisfactorily with the right eye, and sought advice; it was noted that there was a mass about a disc and a half in diameter on the temporal side of the disc and covering the outer third. There was slight oedema of the macular region. V=5/7·5. He came again in September of the next year; the mass had increased in size and covered the disc. V=5/5. A year later the mass was still larger and the retina had become detached. V=1/20. In view of the probable nature of the mass, excision was advised but was not accepted by the patient, until in 1935, he suffered from secondary glaucoma, with much pain. Examination of the excised eye showed a rounded mass springing from the disc and protruding into the vitreous; the retina was entirely detached; the mass was made up almost entirely of new capillaries; in some sections a large vessel was seen which extended back into the nerve, this seemed to be connected with the main central artery. A number of cells were seen to be full of vesicles; these had been probably full of fat, and are in nature similar to those called " pseudoxanthomatous."

The authors think that the accident could not have been the start of the tumour from its slow growth subsequently but that it must have been present for some time previous. They call attention to the slight malignancy of tumours in this place, and to the

" pseudoxanthomatous " cells—which spring from the endothelial cells of the vessels.

HAROLD GRIMSDALE.

(4) **Kenel, Ch. (La Chaux-de-Fonds).—Five cases of opto-chiasmic arachnoiditis of traumatic origin—four confirmed by operation. (Cinq cas d'Arachnoidite optico-chiasmatique d'origine traumatique, dont quatre confirmés opératiorement).** *Ophthalmologica*, Vol. XCVI, p. 336, 1939.

(4) **Kenel** discusses four cases of cranial injury with such general disturbances as headaches, dizziness, insomnia, physical and mental weakness and eye troubles: slight decrease of visual acuity, pronounced diminution of the field of vision in both eyes, increased tension in the retinal arteries, but no fundus lesions. The diagnosis of opto-chiasmic arachnoiditis was confirmed in four cases by operation which produced improvement especially in the field of vision. In a fifth case, no operation was done and vision deteriorated progressively.

ARNOLD SORSBY.

(5) **Walsh, Frank B. (Baltimore).—Ocular importance of sarcoid. Its relation to uveoparotid fever.** *Arch. of Ophthal.*, March, 1939.

(5) **Walsh's** paper contains in its early part six short histories of patients suffering from various forms of sarcoid, which go to show their multiplicity. Case 1 was a woman, aged 56, with lumps in the eyelids, and a mass in the subconjunctival tissue over the right internal rectus. This was excised and found to consist of masses of epithelioid cells and giant cells with surrounding lymphocytic infiltration. There was no caseation and no bacilli were found. The lumps disappeared in two and a half months. Case 2 was a negress, aged 38, with widespread sarcoidosis affecting the skin, liver and spleen, and also producing bilateral swelling of the lacrymal glands. She had a positive Wassermann reaction. Case 3 was a negress, aged 26 years, who developed bilateral low grade uveitis and fever in association with swelling and scab-like lesions of the arms and legs. Transient palsies of the vocal cords occurred. The Wassermann reaction was negative.

Case 4 with a positive Wassermann developed bilateral intra-ocular inflammation, with tumours of the lids and general glandular enlargement. Biopsy of one of them showed changes characteristic of sarcoid.

Case 5, a negro boy aged 14 years, started with bilateral painless swelling of the parotids and changes suggestive of Hodgkin's disease. Diagnosis was aided by radiograms of the bones which showed the changes characteristic of sarcoid.

Case 6, a woman aged 34 years, presented changes in the uveal tract and central nervous system in addition to skin lesions. In another case, reported from the literature, there developed bilateral papilloedema, which in one eye went on to optic atrophy, while in the other, a small mass was observed to be in front of the disc. Autopsy showed masses of epithelioid cells involving the optic nerves, chiasma, cerebral peduncles and left temporal lobe.

From these and other case reports, it appears that uveo-parotid fever and sarcoid may be different manifestations of the same fundamental disease. The nature of this has not yet been conclusively demonstrated, but arguments in favour of a tuberculous aetiology are (1) the occurrence of tuberculous lesions elsewhere in the body; (2) the histological characters of the lesions; (3) the transformation into classical tuberculous lesions that sometimes occurs; (4) the disappearance or alleviation of sarcoid lesions when this happens. It is probable that for sarcoid to develop, the tubercle bacilli must be few in number, and of low virulence in a host who is only slightly allergic and has a high resistance. Another possibility is that the lesions are of spirochaetal origin. Three of the six cases reported by the author had positive Wassermann reactions.

F.A.W.-N.

CORRESPONDENCE

DEMANDS OF THE SERVICES

To the Editors of THE BRITISH JOURNAL OF OPHTHALMOLOGY.

DEAR SIRS,—The letter in your December issue on the demands of the Services asks for an obvious reply.

Mr. Rugg-Gunn's argument appears to be that the mass of ophthalmic work in the Army is refractions, that the energies of Ophthalmologists are being "deflected from their proper sphere of ministering to the need of the civilian community" and that Service refractions should be done by sight-testing opticians under medical control.

Assuming that his argument applies to the Army at Home only, the following observations appear relevant:—

1. The bulk of Army work to-day in this country certainly does consist of refractions—but so does the bulk of civilian work, certainly over 80 per cent. This, however (so far as the Army is concerned) applies only to conditions of "peace," but other contingencies have to be catered for.

2. Much of the purely refraction work in the Army is done by graded ophthalmologists who would be doing the same thing in civilian life. Ophthalmic specialists attached to Military Hospitals undertake duties which correspond roughly with those falling to the lot of specialists dealing with any other cross-section of the community, whether in private or hospital practice.

3. Since, then, refractions it must largely be at the moment, it remains to be decided whether the vision of the Army or the civilian population is the more important. I grant that a strong case can be made out for munition workers in precision jobs; but Mr. Rugg-Gunn's argument in the second paragraph of his letter indicates how exceedingly important he considers vision in the modern mechanized Army; indeed, it would appear not only does the soldier's life but also the continued existence of the civilian community as such depend upon his vision. If we are ever to make up our minds to approach the conditions of total war, the logical conclusion would seem to be that civilian surgeons should hand over their practices to sight-testing opticians and join the Army.

4. This argument pre-supposes that there is an acute shortage of available ophthalmic surgeons—a conclusion with which, with figures at my disposal, I profoundly disagree. Moreover, the bulk of refraction work in the Army now having been completed, its needs are essentially ophthalmologists who can undertake operative work in the field abroad—and these it must have.

Yours very truly,

STEWART DUKE-ELDER.
Colonel.

THE WAR OFFICE, LONDON,
January 15th, 1942.

To the Editors of THE BRITISH JOURNAL OF OPHTHALMOLOGY.

DEAR SIRS,—The letter of Mr. Rugg-Gunn which appeared in your December issue has caused great surprise and indignation among many ophthalmologists as shown by the protests this Board has received. In one paragraph he says that "the ophthalmic surgeon's time, energy and services are deflected from his proper sphere . . . . and relegated to a type of work in which his special skill and experience are largely superfluous." This is indeed a strange doctrine to be preached by a practitioner in a speciality much of whose work must necessarily consist in the *care* of the eyes and not in the more spectacular work of operations. Apparently Mr. Rugg-Gunn would view with equanimity the voluntary handing over of this branch of ophthalmic work to half-trained people.

This attitude is all the more strange because in his final paragraph he is uneasily conscious that he may be adding to the "sight testing problem" which, he says, "we have inherited as a result of the perverse indifference of our profession." If his advice were followed our successors would have good reason to accuse us, not of indifference but of deliberately "selling the pass."

He bases his proposal to hand over sight testing to half-trained people on the ground of alleged reluctance of doctors to specialise in ophthalmology. This was undoubtedly the case before an organised attempt had been made to provide a service for that large mass of our people who could not afford the usual specialist's fee. Then they were practically compelled to go either to the sight-testing opticians or to the out-patients' department of a hospital. But for some twelve years this Board has provided such a service, with steadily increasing success, and the number of men and women entering ophthalmic practice has undoubtedly increased. Does Mr. Rugg-Gunn wish to set the clock back? In any case we have good evidence that his letter will give no satisfaction to anybody except the sight-testing opticians who will regard it, and use it, as a weapon in their unconcealed determination to become what he calls "an ancillary profession."

It will not escape the attention of your readers that Mr. Rugg-Gunn wishes to try out his "ancillary service" on a body of men —those in our Services, who deserve, if anyone does, not a mere makeshift or a second best, but the very best we can give them.

Yours faithfully,

N. BISHOP HARMAN.
Chairman of the Ophthalmic Group Committee of the B.M.A., and of the National Ophthalmic Treatment Board.

ALFRED COX.
Acting Secretary of the National Ophthalmic Treatment Board.

BRITISH MEDICAL ASSOCIATION HOUSE,
TAVISTOCK SQUARE, LONDON, W.C.1
February 6th, 1942.

THE TONIC PUPIL

To the Editors of THE BRITISH JOURNAL OF OPHTHALMOLOGY.

DEAR SIRS,—Mr. Leathart in the February number of the Journal mentions several authors whom he calls "these pioneers." He appears to be unaware of my paper entitled "Notes on a peculiar pupil phenomenon in cases of partial iridoplegia." (*Trans. Ophthal. Soc. U.K.*, Vol. XXVI, p. 50, 1906). In this paper the

tonic pupil is described for the first time in English medical literature. In one of the cases shown to the Society I found the tonic pupil associated with absence of the knee jerks. This was the first observation of its kind.

Yours faithfully,

CHARLES MARKUS.

27, WIMPOLE STREET, W.1
February 11th, 1942.

OBITUARY

JOHN GRAY CLEGG

BRITISH Ophthalmology has lost one of her outstanding personalities in the death of John Gray Clegg, which occurred in December last at Epsom, where he had been living in retirement for some time. There are few of us to whom he was not known and though lately his appearances had been less frequent, his passing leaves a gap in our ranks which it will be difficult to fill.

Clegg was from the North and of the North and he was always proud of his association with this part of the country. There was much of northern ruggedness in his characteristics and outlook on life. Of Manchester parents, he was educated at a famous Manchester school and later at its University where he had a brilliant career as a student.

From his early medical days his interest was centred on ophthalmology and after a short period as resident in a general hospital he became attached to the Manchester Royal Eye Hospital and soon became a member of its honorary staff. For forty years he gave it his devoted service, and it was always his first love—his work and his hobby combined. He held one other major appointment, that of honorary ophthalmic surgeon to the Manchester Royal Infirmary; here he followed in the footsteps of David Little and Hill Griffiths and enhanced the great traditions which they had built up. He resigned this post in 1924 and ceased his active association with the Royal Eye Hospital seven years later. At the British Medical Association meeting in Manchester in 1928, he was elected President of the Ophthalmological section.

Scientific meetings claimed a great deal of his time; he was one of a small group who were instrumental in founding the North of England Ophthalmologieal Society and rarely missed a meeting. In his own hospital, he would usually show an abundance of cases

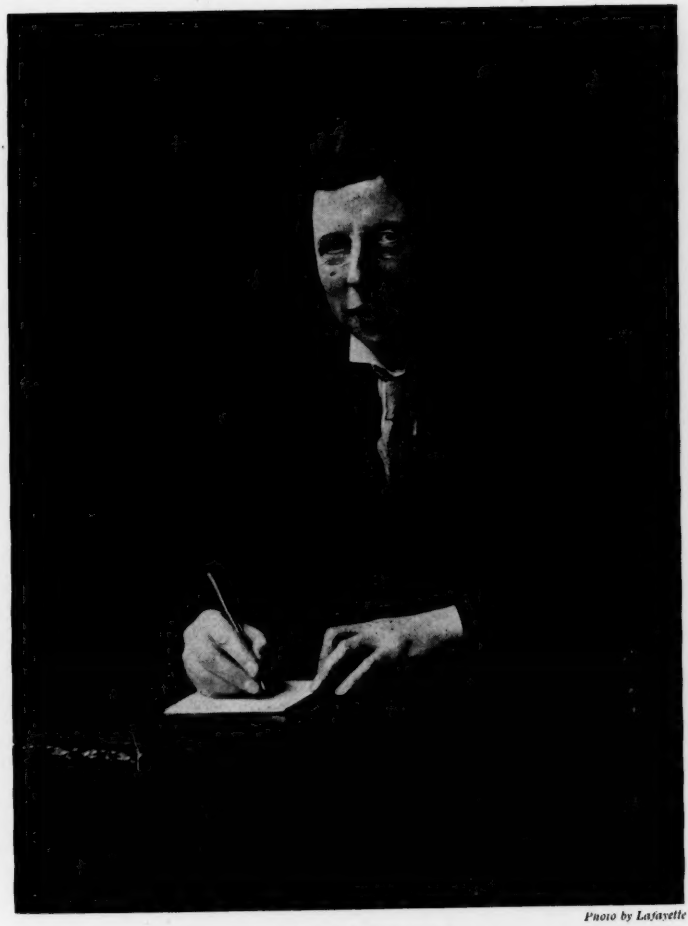


Photo by Lafayette

JOHN GRAY CLEGG

and could always be found the centre of a group discussing the problems he had brought forward. In the subsequent discussion, his knowledge and experience were freely shared with other members. The United Kingdom meetings and Oxford found him a regular attendant and he never ceased to encourage younger men to take an active part in scientific gatherings. He published a large number of papers and travelled both on the continent and in America, where he was particularly well known as a leading British Ophthalmologist.

In medicine, as in other walks of life, a leader possesses certain characteristics that place him above his fellows—a keen intellect, a massive knowledge of his subject, experience and memory. Clegg enjoyed all these, but in addition there was added that rarer gift, perhaps best described as "flair." In his prime, no case and no ophthalmic problem seemed beyond him. He was particularly at his best in expressing an opinion on what we term a "difficult case"—a diagnosis of early intra-ocular tumour or the decision to remove a potentially dangerous eye. His examination of patients was meticulous; only once over many years do I remember his missing an obvious clinical point. So was his note-taking, both in hospital and private practice. He used to teach that the value of note-taking was twofold. First, it provided a permanent irrefutable record, and secondly, it demanded a constant accurate examination by the observer. Younger men would do well to ponder this latter point and learn by it. As an operator, he was sound rather than brilliant, thoughtful rather than spectacular, but for concentration in attention to detail he was probably never surpassed—one thinks of his consistency of perfection in cataract sections as but one example.

Successful ophthalmologists lead a busy life and Clegg was no exception. He had an enormous private practice, but gave much of his time to his hospital patients. He was always striving for something better and his knowledge and experience enabled him quickly to form a judgment as to the value of a suggested new line of treatment—though there was nothing but contempt for the "flashy" and unscientific cure.

He was something of a character, jovial and hearty and always ready to share a joke, for him or against him. A generation of residents will remember his dashes from the hospital—late for his appointments—and the sleeves of his macintosh trailing behind him as he rushed for tram or taxi.

Perhaps two incidents of personal knowledge give a key to his greatness. As is the custom, his application for an important hospital appointment contained numerous testimonials. One was from a famous surgeon, and was quite brief. It read thus: "I have known Mr. J. Gray Clegg for many years. I consider that

any hospital that obtains his services must be considered very fortunate." The second incident was more recent: in conversation with a famous London ophthalmic surgeon the latter remarked: "I never met Clegg without learning something from him."

Spiritually, mentally and physically, Clegg was a large scale man. He devoted much of his time to the Methodist Church of which he was a great supporter. He was a life-long abstainer and non-smoker. In his younger days, Clegg lived a lonely life, dividing his time between his Church, his hospital and his private practice. Later he found great happiness and to his widow we extend our deepest sympathy.

NOTES

William Mackenzie Memorial Medal

THE William Mackenzie Memorial Medal has been awarded to Dr. A. J. Ballantyne, formerly Professor of Ophthalmology at Glasgow University. Dr. Ballantyne hopes to give the customary address at the Glasgow Eye Infirmary in May at the meeting of the Section of Ophthalmology of the Royal Society of Medicine.

* * * *

Oxford Ophthalmological Congress

THE Oxford Ophthalmological Congress will be held on July 2 and 3, 1942. As accommodation is very limited early application is advised. Further information from Dr. F. A. Anderson, 12, St. John's Hill, Shrewsbury.

* * * *

Special Notice

WE are asked by the Ministry of Information to state that the fact that goods made of raw materials in short supply owing to war conditions are advertised in this journal should not be taken as an indication that they are necessarily available for export.

FUTURE ARRANGEMENTS

1942

July 2, 3, 1942.—Oxford Ophthalmological Congress, at Oxford.